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SCIENTIFIC AMERICAN

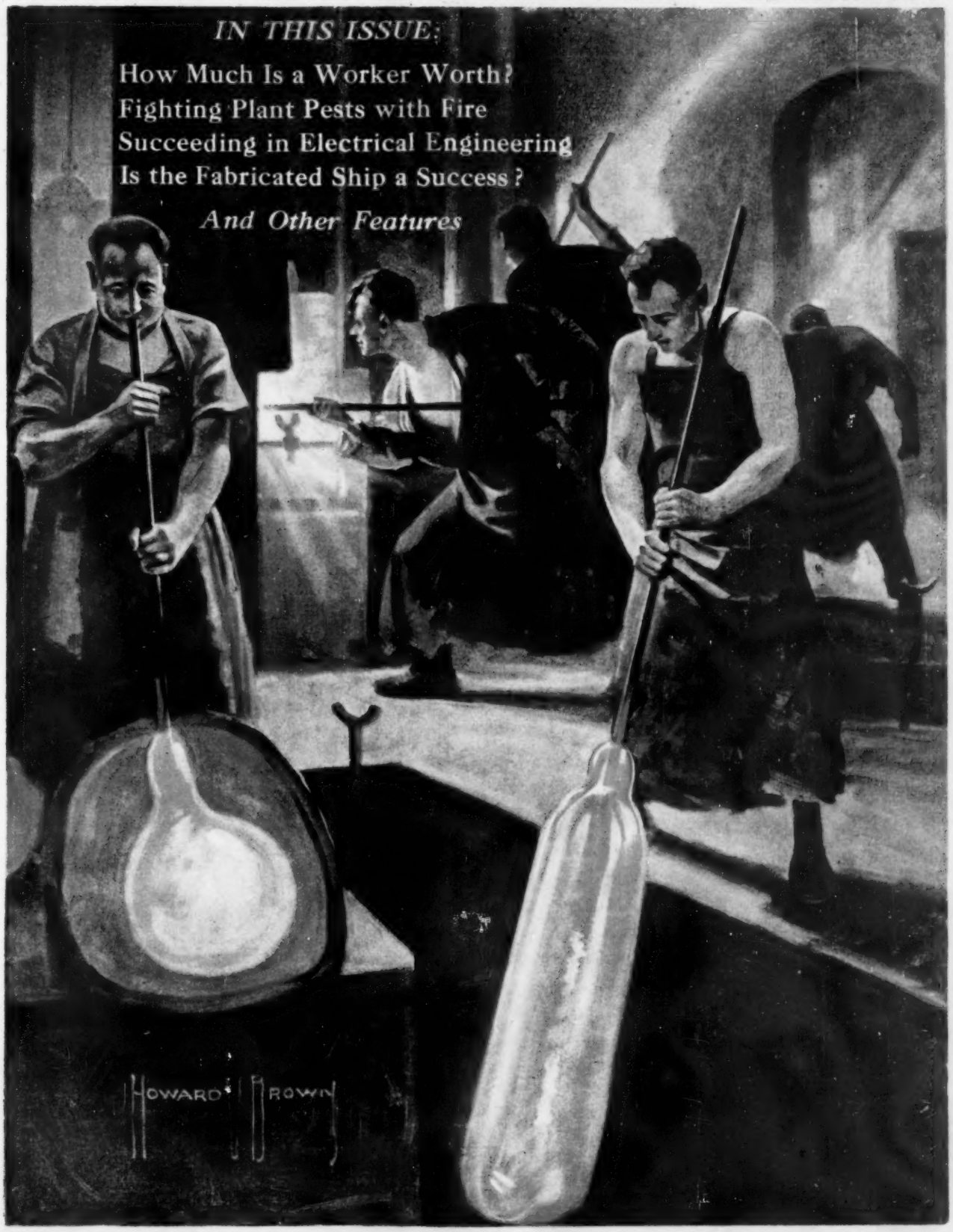
A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

IN THIS ISSUE:

How Much Is a Worker Worth?
Fighting Plant Pests with Fire
Succeeding in Electrical Engineering
Is the Fabricated Ship a Success?

And Other Features



BLOWING GLASS BALLOONS FOR FUTURE WINDOW PANES—[See page 383]

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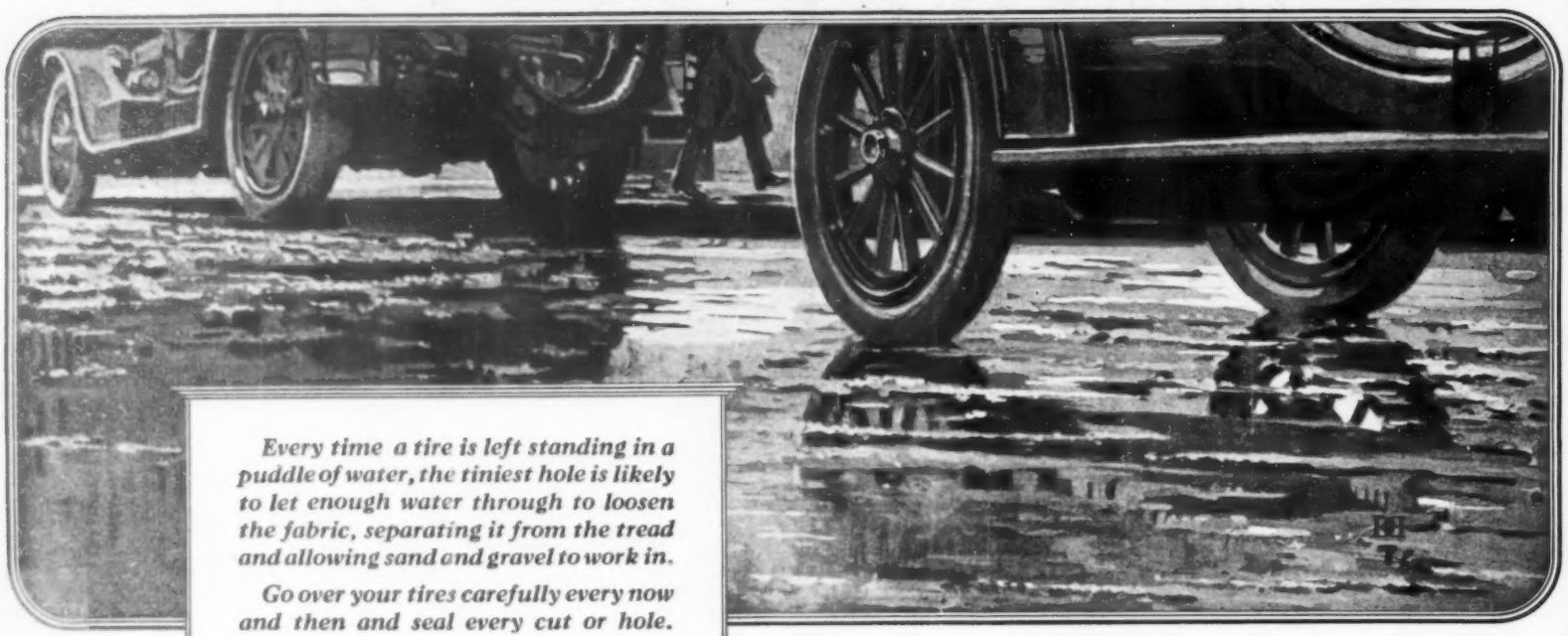
Better Tires *not* More Tires



Every time a tire is left standing in a puddle of water, the tiniest hole is likely to let enough water through to loosen the fabric, separating it from the tread and allowing sand and gravel to work in.

Go over your tires carefully every now and then and seal every cut or hole.

EVERY motorist remembers how it was with his first car. If he heard the slightest unfamiliar noise — a piston slap or a buzzing gear or a creak in the body—it was a serious matter. His friends were always ready with some helpful advice.

But the only time his tires ever made a noise was when he had a blowout.

Then everybody laughed.

The owner generally put on a new tire, paid his losses cheerfully and tried again.

* * *

For years the irresponsible tire dealer traded on the good nature of American motorists.

His idea of business was to sell a man two tires to replace an old one and to console him with the thought that after all motoring is a great "game".

Even today *not one motorist in five* is getting what he is entitled to in tires.

* * *

More and more the motorists of this country are learning that the remedy for high tire costs lies in *better tires*—not more tires.

And that getting better tires means first of all going to the legitimate dealer—the man who sells the known article and who does not attempt to substitute the unnamed or the unknown for the sake of more profits.

Since the beginning the United States Rubber Company has been looking forward to the time when motorists everywhere would come to *quality* in tires.

Building more tires every year, but never more than it could build in conformity with the highest standard of quality.

* * *

The responsible tire dealer never refers to his business as a game. It is a *business proposition* with him—and he knows the only way to make good in business is to make sure of the confidence of the motoring public.

United States Tires

United States Rubber Company

Fifty-three Factories

The oldest and largest Rubber Organization in the World

Two hundred and thirty-five Branches

Every Industrial Executive Needs This Unusual Book

Would you increase your production 12%? Would you cut down your spoilage 25%? Would you reduce the number of accidents in your factory 25%? Would you spend an hour reading a book that tells you how to accomplish these things? If you would, then send for a copy of our latest book, "Benjamin Industrial Lighting." It will come to you promptly with our compliments.

Stripped of all literary verbiage, this book presents industrial lighting facts—scientifically arrived at—that will reveal to you the importance of correct illumination.

Sam Gompers, President of the American Federation of Labor, writes, "Good factory lighting has proved a sure means of forestalling accidents to workmen, and I am glad that American industry is waking up to this fact."

Alvin Macauly, President of the Packard Motor Car Company, writes, "It has been our experience that in the long run good factory lighting costs no more than poor lighting. So why equip with any but the best?" Both of these statements are from men who know.

All that the Benjamin Illuminating Engineering Department has learned about correct lighting based on many years of practical work with America's foremost industrial institutions is concentrated in this ninety-page illustrated book. There are no strings to this offer. Accepting it implies no obligation. It is simply another Benjamin contribution to the progress of correct industrial illumination.

Write for a copy. Then consult your own engineer, contractor or architect as to the best methods of applying to your own plant the vitally important principles laid down.

Address the Advertising Department for full information, 806 W. Washington Blvd., Chicago

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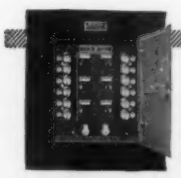
Makers of Things More Useful



Benjamin-Starrett Panels are distributing centers for electric wiring which mark the new safety era in panel board construction. They are approved by the National Board of Fire Underwriters.
Best in material, lightest in weight, smallest in size; they need little labor in installation.
Order Benjamin-Starrett Panel Boards in connection with all correct industrial lighting installations for long, satisfactory service, safety and fine appearance.
Immediate shipments make possible immediate installations.

BENJAMIN PRODUCTS

The following are divisions of Benjamin products on which we will be glad to send information:

Industrial Lighting Division
Electrical Division (including Benjamin Two-Way Plug)
Pressed Steel Products Division
Enameled Products Division
Starrett Panel Board Division

"PERFORMANCE COUNTS"

This is Mack Quality

"A *Mack Truck*, after running 100,000 miles in 5 years was sent to the shop for the first general overhaul. The cylinders were examined for reboring; and it was impossible to discover, on all four bores, a variation of more than .0005 of an inch."

HERE is a tribute to a distinctively *Mack* engineering feature which made possible a remarkable combination of mileage and low operating costs. All *Mack* cylinder castings contain a combination of Gray Iron and Graphitic Carbon to assure a perfect bearing surface. Each block is annealed to relieve internal stress. This unusual, special process is a *Mack* engineering detail.

Thirty-seven distinctive engineering features combine to make the *Mack* the motor truck the world is talking about.

Capacities 1½ to 7½ tons.

INTERNATIONAL MOTOR COMPANY, NEW YORK

Mack TRUCKS

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXII.
NUMBER 15

NEW YORK, APRIL 10, 1920

10 CENTS A COPY
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The Books of Forty Years

By Fred E. Woodward

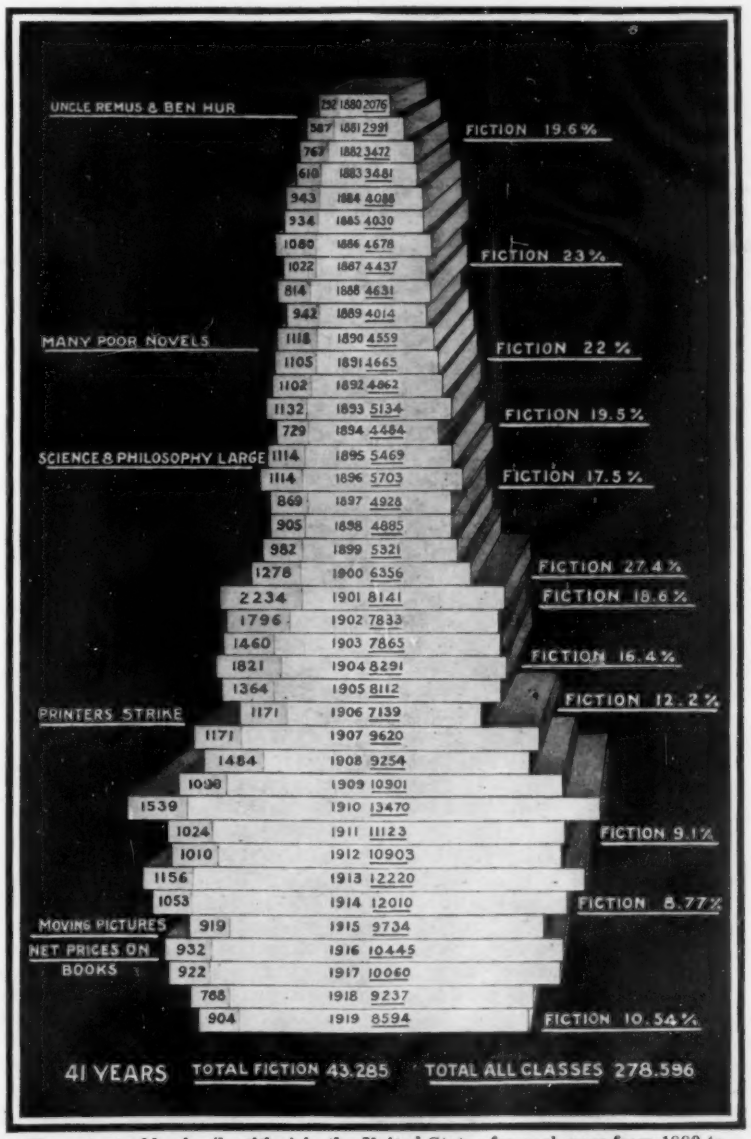
HEREWITH we present a diagram showing the number of book titles issued in the United States from 1880, when the first annual record was made, down to the year 1919. It will be seen that in general terms the publication of new books showed an ever-increasing number of titles down to 1910, since which date the trend has been in the opposite direction, showing fewer titles each year with one or two exceptions. The volume of fiction, indicated by the shaded portion at the left end of each annual block, has been less consistent in its fluctuations, increasing and decreasing apparently at random from year to year.

When we look closely at the march of events for the various years, however, it is often the case that an otherwise inexplicable variation in book publication can be accounted for, in part at least. Thus 1887, the first year showing a shrinkage on our chart, was a year of great labor disturbance, with many men on strike for a long time; and this might not unfairly be expected to have some effect upon business conditions sufficient to deter publishers from the more speculative ventures. There seems no adequate reason for the falling off in 1889; but in 1894 there was the aftermath of a panic, when once more publishers were cautious and readers less liberal.

The remarkable growth from 1900 to 1910 is indicative of a nation-wide impulse toward scientific development. It was during this period that we first began to pay attention to the library reports that anywhere from 80 to 99.44 per cent of all calls were for non-fiction, and that reading and study were going on in quarters to which they had never before penetrated. The temporary falling off in 1906 must be attributed to the big printers' strike of that year. The peak of 1910 marks perhaps the crest of interest in such topics as the invention and widening use of the automobile, the development of the airplane to something that was obviously headed toward success, the invention of wireless, and the broad public interest in applied science, useful arts, business, philosophy and economics. The falling off since that date has been what might be called a matter of common consent between reader and publisher. The cost of publication has been leaping upward with great rapidity, while at the same time world events of such nature have been transpiring as to distract the attention of many prospective readers of books to more vital concerns. Some notion of what was going on during the ten years of expansion may be gleaned from the figures for a single class. In 1906 there were 190 new titles listed under Applied Science and Technology; in 1910 this had grown to 857.

Of interest also is the relation of fiction to the whole. Running steadily in the neighborhood of 20 per cent for many years, the fiction showed a tendency toward periodical expansion in the 90's, and finally in 1901 attained 27.4 per cent of all the titles that were put out. Since that date however, as might have been anticipated from what we have said of the "revival of learning," fiction has fallen away until today its normal volume seems to be one-tenth of all the books produced.

As a matter of mere curiosity, it may be worth recording that for the entire period covered by the chart the output of titles in all fields was 278,596 and of fiction 43,285.



The output of books (by titles) in the United States for each year from 1880 to 1919, and the relative bulk of the fiction and the non-fiction. The lengths of the blocks for the several years, and of the shaded and non-shaded portions, are proportional to the numbers of titles represented

Making Window Glass

OUR cover this week shows a typical scene in a factory for the making of the ordinary window glass—a branch of manufacture that is today of more than ordinary interest in the non-Teutonic countries of Europe, by virtue of the efforts being made to foster home production and thereby break the German monopoly which existed before the war. It is perhaps not generally known that the formation of the thin sheets of glass called for by the glazer follows the rather roundabout formula of blowing the glass into cylinders, to be later slit and flattened out into sheets; but this is the fact.

Lumps of the raw glass are attached in furnaces to the ends of long tubes, and then heated to a sufficient temperature to permit of blowing. The entire blowing cannot be performed in a single operation, both because it is still done by human wind-power of which no man has enough to blow a complete cylinder of the necessary size, and because the glass will not hold the blowing temperature long enough. In practice this tendency of the glass to cool is actually accelerated, in the first stage of the operation, by water sprays. In this stage the lump of glass adhering to the end of the tube is blown into a more or less indefinite shape, of which little more can be said than that it is roughly globular and quite small. It then goes back to the furnace for reheating, and after the next bout with a blower it has become considerably enlarged and assumed the general shape of a pear. The blower during the formation of this big bubble is relieved of the necessity for supporting the entire weight of glass and tube; a wooden form of the appropriate hollow shape is provided for him to rotate the glass in. The third stage of blowing brings the glass into the form of a long cylinder of very even section; so long, in fact, that pits have to be provided for the accommodation of the glass. The blower stands on the edge of these depressions and holds the long, narrow bubble down in them while he works at it. Our cover makes this procedure clear.

The ends of the cylinder thus formed, of course, are closed; the blower and his assistant carry the cylinder down a sloping platform and place it in position on a bench, where it is held by wooden wedges. The two ends are removed, and then a rim of molten glass is smeared around the line of cleavage at each end, to prevent splitting. This is easily effected by taking a lump of semi-molten glass on the end of a small rod and using the latter as a brush, drawing it about the circumference of the cylinder-end.

With both ends thus opened and made secure against damage, the cylinders are placed, usually three in a row, on a bench. Here they are cut longitudinally by a diamond cutter, a single slit being made in each cylinder from end to end—not two slits. The slit is held open by the insertion of one or two small wedges, and the glass now is ready to go to the heating oven for flattening.

It is conveyed into this oven mechanically, and deposited on an iron table with a stone top, which is moved back and forth inside the oven by means of a long rod protruding through a hole in the oven wall. The "ironer" stands at the door of the oven, and after pushing the glass off the loading frame and on to the table, he works at it with a tool consisting of a long handle with a block of water-soaked wood at the business end. The assistant at the table-controlling rod moves the table back and forth at the ironer's command, until the glass has been successfully reduced to a flat sheet.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Why It Does Not Work

MUCH talk is made about the law of supply and demand, which is represented, usually, as a universal and immutable principle that governs the price of things much as the law of gravitation governs their position and movements. The idea seems to be that the price moves in some fashion directly controlled by the excess of supply over demand or demand over supply. If justification were demanded for putting the matter thus, we should probably argue that when the supply is greater than the visible demand, an artificial demand must be created by making the price so attractive that, whether for investment or for future needs, people will buy who would not ordinarily do so. On the other hand, if the demand is greater than the supply, the only way in which 10,000 articles can be made to go around among 20,000 potential consumers is by elevating the price to such a point that half these people can not or will not meet it.

Now this is very pretty indeed, this scheme which nature has worked out and bestowed upon man for creating a demand sufficient to absorb any excess supply, and equally for curtailing the demand in the interests of a restricted supply. But it will be noticed that in both cases the adjustment is made by manipulating the demand. The supply, apparently, is to be assumed fixed and immutable—at least until another producing season rolls around with its appeal to the producer to make more or less goods. When there is too great a supply, demand must be stretched; when there is too great a demand, again demand is to suffer the Procrustean process and be cut down.

In earlier and simpler days we have no doubt that this worked out very nicely. But today when we go through the motions of cutting down the effective demand, the effective demand simply refuses to be cut. We have a condition which appears entirely novel, in that the consumer refuses to adjust his wants to the visible supply. If shoes are so scarce that the price doubles, according to all the rules of the game the demand and the sales ought to be cut approximately in half. Are they? Emphatically, they are not.

The consumer of today is a light-hearted, merry soul. If he could buy his shoes for five dollars, he would presumably do so—save for the relatively few foolish folk who think that dollars and quality are synonymous. If he must pay ten for them, he kicks mildly—and pays the ten. If the price jumps to twenty—well, his protests may be more audible, more indignant, he may insist with greater vehemence than before that the whole system is rotten and that something ought to be done about it—but he pays the twenty.

We are apparently the victims of an unexampled and unexpected prosperity. Everybody has more money than he ever had before, and has so firmly acquired the mental habit of having money that the possibility never occurs of its future scarcity, or of the desirability in spending it of asking for a fair equivalent. We see what we want and take it away with us—we may protest that the price has gone up inordinately but we pay just the same. And in the other direction, when it comes to adjusting the demand so as to take care of over-production of certain lines, we are just as inflexible. Of several grades of the same article, everybody insists on having the best and nobody will take the medium and poorer qualities, of which there is therefore a glut.

We talk about the law of supply and demand. Then we go right out to the butcher and the grocer and the drygoods store and arbitrarily refuse to give the poor old law a chance to function. If supply can't be immediately adjusted and demand won't be, what can be expected save prices that really will operate to freeze out entirely those whose resources are least? Not until we begin to adjust our demand very generally and on a very earnest scale may we expect to see any material reduction in prices. If we will, as a nation, use old equipment of every sort until we have squeezed out the last drop of utility, and of the things that have to be bought buy the very poorest grade that will approximate satisfaction, we may hope for price adjustments. But between a rigid supply and an inflexible demand, what adjustment can there be? When an irresistible force meets an immovable obstacle, pity the poor fellow caught between—and then stop to ask whether after all if it is not this fellow's obstinacy that makes the obstacle an immovable one.

Tool versus Toy

ADVOCATES of the good old fashioned way of doing things are sometimes fond of telling about the business man who boasted to his acquaintances of the wonderful new filing system he had just installed. A few weeks later he encountered the same party at lunch, and they asked him how the new filing system was coming along. "Splendidly," he replied; "We have given up all other business to attend to it."

This illustrates excellently that new equipment must replace old equipment, or it cannot profitably be installed—barring, of course, the case where it is intended to take care of expansion of the business. When the typewriter was a novelty, for instance, no house could afford to buy a machine unless it was to do the work of more than one scribe; for if it did not, it would not pay for itself. We set up our books and magazines on the linotype and the monotype because when we have these machines we do not have to set up by hand. We buy a motor truck because it replaces our horse trucks. If replacement were not to be thus realized, we would not buy the machines.

All this seems simple enough; yet there are many fields where these general principles are ignored, and many isolated instances besides of ignorance concerning them. At least one manufacturer of adding machines and similar equipment advertises that he will not sell you a machine until he has looked into your business and convinced himself that you can use it profitably. And among the vast number of similar cases, we may select for further discussion that involving the tractor.

Nothing that we may say here will be construed as a criticism of the tractor, because it would be futile to criticize it; it is established. But the motor truck is established too; yet we would laugh at a man who would purchase a truck to deliver a few loaves of bread each morning to the residents of his immediate neighborhood—we would laugh at him as heartily as at the gentleman who swats flies with a pile-driver. Just so in the case of the tractor.

It is not merely that tractors are put out which will not do all the work of a horse, so that the farmer who buys the tractor still has to feed and maintain horses. It is not merely that in some quarters farmers are indiscriminately urged to buy tractors, whether they need them or not. There is a hitch deeper than that.

Suppose that Hi Hankins of Squeedunk, to follow convention in the baptism of rural locations and characters, is working his farm with four horses. If a tractor is offered at the price of these four horses, the question is a simple one—will it do all the work of the farm, at a lower operating cost than the horses? If it costs more than the horses, the question must be modified and a more critical examination of relative operating costs made to justify the proposed capital expenditure. If the machine is offered at the price of two horses, it must do the work of two horses at a favorable operating cost. Everybody understands this factor of operating cost; but few understand the factor of capital expenditure. No matter how much a machine costs, if it saves enough in operating expense to pay interest on its cost it is profitable; no matter how cheap its purchase price, if it does not save interest it is expensive.

After all the demands of ordinary common sense have been met, there is this question to ask. The machine must always be rugged and fool-proof and a host of other things. But after all this, is it offered at a price that makes it a tool or a plaything? A tractor that costs more than the capital value of the work it does is all right for the gentleman farmer, who is usually more concerned with methods than with results: the man who is growing crops for a living must demand that it stand on its own feet. And the same comparison holds good for all fields of business. Are you in business for your health? If you are, you can afford business luxuries that do not earn their keep. Otherwise you cannot. And they must earn their keep not merely when considered in connection with their operating cost, but equally when referred to the cost of installation.

The Spirit of the Time

TO anyone conversant with the history of science and invention it is a familiar fact that great discoveries and inventions, for which the world may have been waiting for thousands of years, are suddenly made, when their hour does come, by several men independently at almost the same time. Examples could be quoted in profusion. It will suffice here to point only to the enunciation of the law of conservation of energy by Mayer in 1842, by Joule and also by Golding in 1843; and the development of the infinitesimal calculus by Newton and by Leibnitz.

Cases of this kind are too frequent and striking to permit of our regarding them as simple coincidences. The human mind, brought face to face with such a fact as this, instinctively, and involuntarily, seeks an explanation.

One such explanation, to which Emerson gave the weight of his authority, is that the thoughts of man are not simply the product of his own individual mind, but are the expressions of a cosmic consciousness: "We lie in the lap of an immense intelligence which makes us organs of its activity and receivers of its truth. . . . The men who come on the stage at one period are all found to be related to each other. Certain ideas are in the air. We are all impressionable, but some more than others, and these first express them. This explains the curious contemporaneousness of inventions and discoveries. The truth is in the air and the most impressionable brain will announce it first. . . ."

There is something attractive in the thought that we are thus the receivers and the mouthpieces of a great and wonderful higher intelligence. But, without denying the possibility of truth in this pleasing perspective, it must be said that, in the light of cold reason, the phenomenon of simultaneous discovery can be accounted for, in a measure at least, without invoking any agency other than those with which we are well acquainted in the ordinary course of life.

Given a world of many millions of men, cast, as it were, in approximately the same mold, and living together in a contemporaneous and common environment, it is rather to be expected that there will be a tendency for them to react in somewhat similar manner to that gradual modification of the environment which is conditioned by the accumulation of human knowledge through tradition and written records. In other words, the men of 1900 have approximately similar native endowments, and therefore react similarly towards the conditions of 1900; but their reaction to these conditions is obviously different from that of the men of 1800 to the environment of their day.

For this reason it is perhaps not to be so greatly wondered at that H. G. Wells, novelist, should, in his book "The Time Machine," have anticipated some of the conceptions which have introduced such radical new departures into modern physics in the form of the relativity theory. The remarkable fact is, nevertheless, worth recording, and undoubtedly stands as a testimonial to the wonderful width and clearness of intuitive vision of the English novelist.

Electricity

French Radio Stations in Wartime.—In a recent issue of *La Nature* there appears an interesting account of the work of French radio stations during the war. Descriptions are given of the wireless installation connected with the Eiffel Tower in Paris, and various other stations at Lyons, Nantes, Bordeaux. The author states that during the war some 50,000,000 words were tapped, and during the same period about 1,500,000 transmitted. Useful as the system was during the war, considerable advantages have been gained from it since the armistice in constituting a method of communication between the Allies and those countries to which telegraphic lines are lacking.

Future Electrical Development.—A contribution to the gas vs. electricity discussion appears in a recent issue of the *Times Engineering Supplement*. The plea is entered that the electrical engineer should preserve a more or less open-minded attitude towards the claims of gas, so that a more just estimate of the corresponding advantages of electricity can be formed. The unfavorable position of electricity as regards domestic heating and cooking loads, is dealt with at some length. Lighting and power demands, however, can much more satisfactorily be dealt with by electricity, and it is concluded that in these directions there is no need for misgiving among electrical engineers. Cooking and heating are not likely to be serious factors in the growth of electricity supply.

Electrolytic Damage to Cables.—Numerous recent breakdowns in the underground cable system of St. Louis are attributed to electrolytic damage done to the lead sheathing several years ago within a few months of the cables being installed. The delay in actual burnout is due to the slowness with which moisture penetrated the varnished cambric insulation. In many cases, the immediate cause of breakdown was overheating resulting from the increased dielectric loss in the moist insulation. Many failures were due to surges set up by burn-outs at other points in the system. The investigation shows the importance of keeping close watch upon electrolysis conditions when new installations are made.

An Outdoor Service Foot Warmer.—For those who must work in the open for hour after hour in winter weather, there has been developed an electric foot warmer of substantial construction. The foot warmer in this case is simple and absolutely waterproof. It is made in one piece and the top surface is diamond treaded. Feet are provided at the corners to raise the device one inch above the ground or floor. The warmer is manufactured in two sizes, one of which, measuring 14 inches wide by 20 inches long and 3½ inches high, is made of either cast iron or brass. It consumes from 50 to 200 watts, depending on the amount of heat desired. The small type measures 12 inches wide by 16 inches long and 3½ inches high, and is rated at 200 watts. The foot warmer is intended for gatemen at railroad stations, crow's nest aboard battleships, sentrymen aboard passenger ships, footmen on duty at clubs, watchmen at large industrial plants, and all others who must remain in one spot for long periods of time.

Laboratory Uses for Variable Condensers.—The excellent variable condensers as now made for wireless telegraphy may find various uses in the laboratory, owing to their good insulation and easy control. Thus the measurement of explosive potentials can be made directly, instead of by the micrometer sparker method and tables, by a slight modification in the secondary circuit, which nearly always includes a variable capacity condenser. After fixing the maximum electrode separation which gives a spark on an ordinary spark-gap, the latter is connected to the terminals of the condenser, which is brought up to its maximum capacity. Charging is then effected from a suitable relatively low constant potential source, turning continually to zero. As the potential difference between the armatures thus continually increases, a moment comes when a spark is produced. A direct-reading Braun or sheet electrometer, previously graduated, will give the potential difference when the spark appears. In the same way the necessary potential difference for the lighting of a vacuum tube may be measured, say in comparing Geissler tubes.

Science

New Magnetic Charts.—A new chart of magnetic declination for western Europe for July 1, 1919, was prepared by the Carnegie Department of Terrestrial Magnetism in October, 1918, for the use of the American Expeditionary Force, in response to a cable request from staff headquarters. The lines of equal declination are given for every 20 minutes and are based on all information available. Isomagnetic charts for western Canada, 1917.0, have recently been published by the Topographic Surveys Branch of the Canadian Department of the Interior, Ottawa.

The House of Priestley.—The house at Northumberland, Pa., in which Joseph Priestly, the discoverer of oxygen, lived and conducted his researches after his removal from England to America in 1794, has been bought by chemical alumni of the Pennsylvania State College, and an unnamed donor has provided funds for its removal to the college, a distance of 60 miles. The building is of wood and in a state of excellent preservation. It will be reconstructed on the campus along the old architectural lines, but adapted for some suitable use by the School of Natural Science.

Weather Forecasts for Alaska and the West Indies.—The last annual report of the U. S. Weather Bureau records that two new "forecasts districts" were organized during the past fiscal year, one having its headquarters at Juneau, Alaska, and the other at San Juan, Porto Rico. From Juneau are issued daily forecasts for the Juneau district of southeastern Alaska throughout the year, and for the lower Tanana Valley during the period of low temperatures. As an aid to this service arrangements have been made for establishing meteorological stations at Atka, Akiak and Noorvik, to report twice daily by radio. The San Juan office issues forecasts and warnings for the part of the West Indies lying east of longitude 70 degrees W.

Scientific First-Aid for Legislators.—In a recent presidential address before the Royal Society of New South Wales, Dr. J. B. Cleland called attention to certain results of inadequate scientific knowledge on the part of Australian legislators, and offered a suggestion that commends itself to consideration in other parts of the world. He proposes that one or two "royal commissioners of science" be appointed in each of the Australian Parliaments, who should have the right to be heard at the bar of the House on any matter in which science plays a part. Their duties would be to ascertain from authoritative sources and to assess the scientific aspects of any question submitted to Parliament. They would devote their whole time to this work and be paid such salaries as would attract men of the highest talents.

Weather Forecasting from "Solar Constant" Measurements.—In a recent lecture before the Washington Academy of Sciences, Director C. G. Abbot, of the Smithsonian Astrophysical Observatory, described the use that is being made of "solar constant" observations by the meteorological service of Argentina as a basis of weather forecasts. The head of the Argentina forecasting service, Mr. H. H. Clayton, after an extensive comparison of weather records in Argentina and the solar observations at Mount Wilson, announced that he had found evidence of a very marked influence of abnormal solar constant values upon both temperature and precipitation. The effects follow by some days the times of maximum and minimum radiation. In July, 1918, the Smithsonian Institution established a new station for solar observations at Calama, Chile, and ever since December, 1918, a daily code telegram has been sent from Calama to Buenos Aires stating the intensity of solar radiation outside the atmosphere. One curious fact revealed by this undertaking is stated to be that the dependence between solar variations and changes of temperature at Buenos Aires occur in opposite senses at different seasons of the year. From October to February low values of solar radiation are followed for several days by negative temperature departures from the normal, while the reverse is true from March to September. Occasional exceptions to this rule are recorded. Dr. Abbot thinks that this new auxiliary in forecasting is so promising as to justify the expense of establishing additional solar constant stations in other regions of the world favored with clear skies.

Industrial Efficiency

An Enviable Safety Record.—In a report recently issued by the Chicago Elevated Railroads, attention is called to the fact that these lines have operated for eleven years without a single fatal accident to a passenger on a train. During this period approximately two billions of men, women and children have been carried. For the year ended December 31, 1918, the amount expended for damages amounted to only 1.3 per cent of the gross operating revenue. It is claimed that this notable record is unequalled by any similar transportation company.

Film Propaganda.—The United States Fuel Administration has prepared a fifty-minute film of motion pictures, showing good and bad operation in steam boiler plants, methods of testing boilers, and the like. These pictures will be available to each state in connection with its educational propaganda to conserve the fuel supply. The Administration is also preparing a series of official bulletins on engineering phases of steam and fuel economics, some of which are now ready for printing. They will include Boiler and Furnace Testing, Fuel Gas Analysis, Saving Steam in Heating Systems, Boiler Room Accounting Systems, Saving Steam and Fuel in Industrial Plants, Burning Fine Sizes of Anthracite, Boiler Water Treatment, Oil Burning and Stoker Operation.

Safety Through Peephole Instruction.—The success of many educational systems has depended upon an appeal to human quality of curiosity and its development into sustained interest. Acting on this principle the safety department of a manufacturing company of Elmira, N. Y., has combined a picturescope with the safety bulletin board, with the result that large crowds of workers gather around it in the noon hour competing for a "look." The device, continues *Safety*, is simply a box with a "peephole" and a lever by means of which a light is turned on within the box and the picture illuminated. The pictures are changed every two days, and are usually cartoons or other illustrations of a humorous nature having some relation to unsafe practices and the application of safety axioms.

Results of Army Training Along Technical Lines.—That manufacturers throughout the country are awakening to the realization of the thorough training along technical lines that the Army is now giving its men is evidenced by the following letter received by Lieut.-Col. D. D. Eisenhower from a motor manufacturer. "Thank you for your favor of the 27th inst., which the writer has carefully read. Should any of the men, after graduating and receiving their certificate, present themselves here and make application for employment at any time, and presenting their discharge papers from the Tank Corps with the notation 'Character excellent,' and a certificate showing them to be qualified mechanics, we will be very glad to give them the best available positions which may be open at that time. We can use a number of such men immediately. We very much appreciate your interest and trust we will soon have a number of your graduates in our employ."

Belgian Iron Industry.—Although certain branches, notably the iron and steel industry, are swamped with orders, not only for home consumption, but also from abroad, most of the factories, with order books filled up, are operating cautiously in view of the instability of labor conditions and of provisioning in raw material, which has become a serious problem. One of the best proofs of Belgium's improving system is shown by conditions in the export market, in which iron and steel manufacturers have succeeded in underbidding their rivals with regard to cast steel and other products. England, for instance, has ordered considerable cast metal from Belgian producers. The prices continue to increase in view of the growing number of orders and the lack of available products. Lack of coke has prevented operation of new blast furnaces. The only Belgian factory actually producing electrical steel is swamped with orders, and it appears that hereafter it will not be necessary to go to Germany for this product. There is considerable demand for construction material, notably from the devastated regions in the north of France.

Is the Fabricated Ship a Success?

Some Instances of What Standardized Construction Has Meant In Actual Operation

By Robert G. Skerrett

DID we gain anything of technical value, of engineering permanency in the realm of shipbuilding because of the feverish urge of war? Are we in a position today, owing to what we learned in those two anxious years of our participation, to hold our own more effectually against foreign competition? In short, can we turn out better steel steamers and sell them profitably at lower prices than such craft can be secured abroad? Finally, have our cargo carriers, by reason of their manner of getup and outfitting, virtues which will enable them to operate more economically?

These questions concern every American interested in the upbuilding and the maintenance of our merchant marine and the continued employment of productive facilities, largely brought into being in the course of the past three years. There is a widespread disposition to believe that much of the work done by us in creating vitally necessary ocean-going freighters was of merely temporary value. There is a conservative element that insists upon a general return in the shipbuilding industry to practices that long prevailed in the pre-war period. These gentry point out that the standardized vessel was all well enough as a more or less military necessity, but they insist that the shipowner and the ship operator will now want to go back to the days of multiplicity of types and the fashioning of steamers to suit the divers likings, yes whims, of purchasers and prospective clients.

From an engineering point of view, using the term in its broadest application, this would be going counter to that national spirit of advance which has made possible the quantity production of the present-day automobile, motor truck, farming machinery, and a score or more of other products. Standardization has not only cheapened the ultimate cost to the consumer, but it has permitted of a volume of output which has enabled us to supply both our own demands and to reach out and command an immense business in the markets of the world. It was upon standardization that the nation mainly relied to provide ships fast enough to neutralize the grim activities of Teuton U-boats; and thus were established three plants designed particularly to construct so-called fabricated ships—freighters which should be built by manufacturing methods and repetitive processes.

It is a matter of common knowledge that we were able to do this only by resorting to a revolutionary procedure which called for the coördinating, the merging of two radically different arts—those of the marine architect and the structural steel engineer. The public at large is quite unaware of the labor that this involved, of the mutual give and take in order to produce a floating body which could utilize to a very wide extent the materials and the methods in general use in the rearing of bridges, skyscrapers, and allied undertakings ashore. It will be recalled by readers of this journal that the skeptical freely predicted that the fabricated ship would be little better than a sieve, for they were certain that no structural steel worker could drive rivets tight enough to meet the requirements of marine architecture. The results have been happily quite the opposite.

Success in the face of gloomy prophecy was won owing to a number of contributive factors, and these should be specified because they represent departures in marine practice which have firmly established their claim to continuance. To begin with, the bridge builder has been employing for years soft steel where his brother, the shipbuilder, has relied upon a metal of higher carbon content costing more, pound for pound, The harder steel in marine work has permitted rougher, one might correctly say more abusive treatment, while still leaving the metal generally strong enough when in place to meet an accepted standard of service. The bridge builder, on the other hand, has so manipulated his softer steel, so considerately prepared it for its designed function, and so assembled it in his fabricated structure that his metal was unharmed during these processes and capable of providing its full measure of initial strength. His bridge, unlike the average ship, was not tortured by internal stresses ready to combine with outside forces to bring about disastrous strains and, possibly, collapse. And it should be borne in mind that the softer steel will give and bend where the usual ship steel will break under impact. This means that one craft, though badly dented, will remain watertight where the other may leak menacingly as the result of a collision or of grounding.

The manufactured vessel, in the second place, is especially strong structurally and watertight because its metal elements are brought together snugly, are duly

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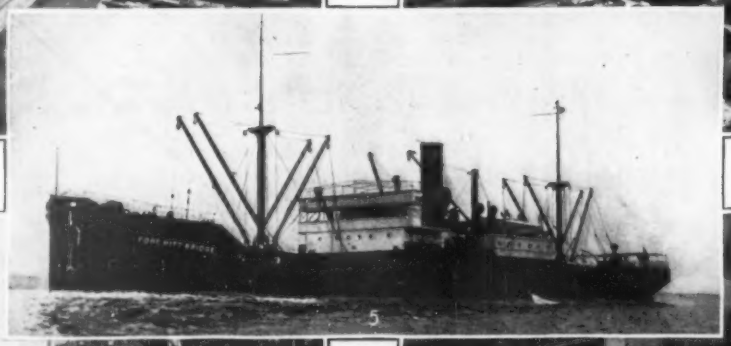
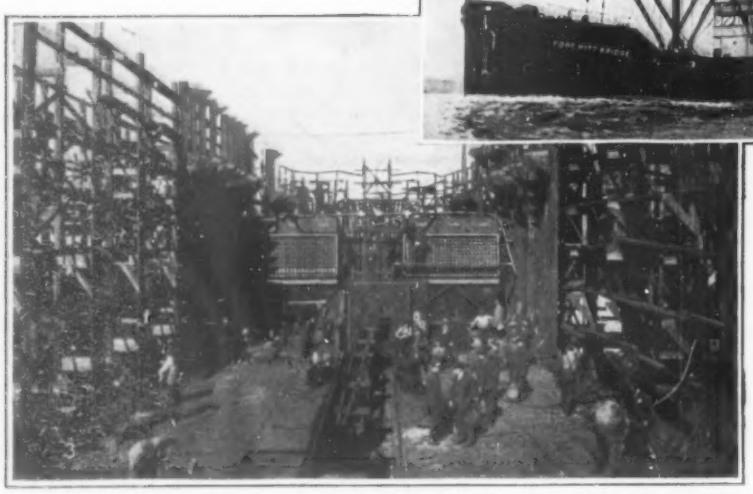
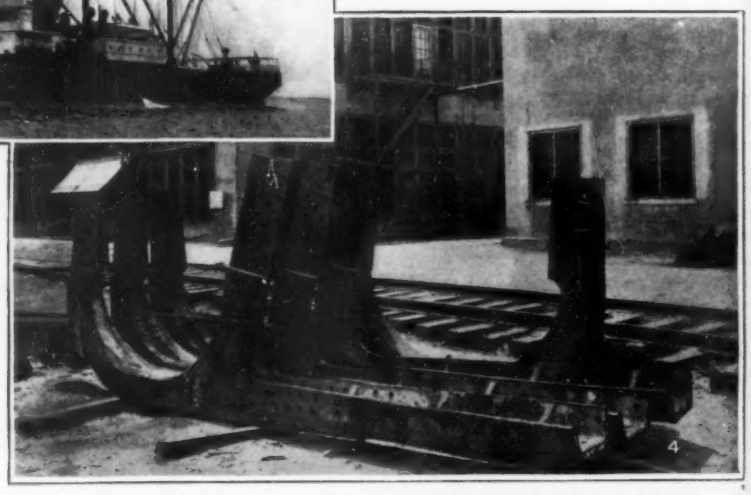






1.—Part of the "stock room" of a yard for the assembling of standardized fabricated freighters. Exactness of manufacture is the keynote that has dominated in producing this array of equipment. 2.—Some of the thousands of identical fittings and equipment which can be installed with equal facility upon any and all of the manufactured cargo carriers. 3.—The water-tube boilers of the fabricated steamer can be put in place as the hull grows upon the blocks. 4.—Difficult forgings fabricated by repetitive methods susceptible of being worked without further treatment into the bodies of any fabricated craft of a given displacement. 5.—A fine example of the standardized cargo carrier produced by manufacturing methods

Graphic proofs of how the structural steel worker has co-operated with the marine architect in producing ships in quantities

1.—Airplane forest-fire patrol over the San Bernardino Mountains in California. Note the fire breaks on the long ridges. These were constructed and are maintained by the Forest Service in order to check the spread of fires until fire-fighting crews arrive on the scene. 2.—Airplane forest-fire patrol in southern California near Bear Lake. 3.—A forest fire from the air

How the winged forest patrols do their work

Winged Patrols for Our Expansive Forests

By Richard F. Hammatt

AT nine o'clock on the morning of June first of last year, five airplanes left the ground simultaneously from three widely separated California flying fields. These five ships piloted and maintained by Air Service personnel, were bound, not for a pleasure jaunt, not for a training trip over broad, smooth valleys, but for five separate patrol routes over some of the roughest and most heavily timbered of California's mountains. They accomplished, on that date, the initial flights of what was the first organized and sustained airplane forest-fire patrol ever undertaken in the United States or, so far as has been ascertained, elsewhere.

The possibility of using airplanes as an agency in forest fire protection had, it is true, been mentioned as early as the year 1909, when a convention of forest Supervisors, held at El Paso, Texas, recommended that air patrol be given a trial. And the first actual test of record was in Wisconsin in 1915, when a Curtiss four passenger flying boat equipped with a Curtiss eight-cylinder V-type, 100-horse-power motor,— a ship owned and operated by L. A. Vilas— made a few trial flights over the forested area in the vicinity of Big Trout Lake.

But the California experiment—for it was an experiment—was of a different caliber. It was known that smokes could be seen from the air. But could they be accurately located and promptly reported? Could a daily and uninterrupted service be continued for month after month? What were air conditions over the mountains and what type of ship would best meet those conditions? What would be the best and most practicable means of reporting fires? These and many other questions were asked.

Asked—and answered, every one of them; for this experiment was different from the Wisconsin one. It was organized. Fire patrol of the California National Forests was the practical object sought. Regular patrol routes were laid out, control points established, and time schedules drawn up. An extended and uninterrupted service was planned. The ships started and, with surprisingly few exceptions, landed almost exactly on schedule. The routes were closely followed. And fires, hundreds of them, were discovered, located and reported.

The unique method of patrolling the forests began as I have said, on June 1. It covered, with only five ships flying in any one day (five others were held in reserve, and were used on alternate days) some five million acres of National Forests. Its job was to supplement the work of the regular Forest Service lookout system—a system of stationary lookouts located on the highest peaks, who watched for, located and reported by telephone to ranger and to fireman every smoke that reared its head above the tree tops. And they helped guard, these flying smoke-spotters, some 20 million feet of magnificent timber worth more than 40 millions of dollars!

Did they deliver the goods? They did; for during June, July and August the pilots had maintained an uninterrupted service, had covered 92,605 miles over rough, mountainous country, and had discovered and reported a total of 118 fires, 23 of them in advance of the regular Forest Service organization. They had accomplished this with Curtiss ships—J N D 4-s—"Jennies," as their pilots called them.

On August 15 the Northern California hunting season opened, and with it came an alarming increase in the number of forest fires. So widely were they scattered, so quickly were they set, so dry was the ground cover and so inaccessible was much of the country that the situation became critical. Emergency precautions became imperative. Airplane patrol had proved its worth over five million acres and its extension to cover the entire 18 million acres of National Forests in the state was, therefore, asked.

The request was granted. The service was reorgan-

(Continued on page 404)

Multiple Wheel Truck and the Pneumatic Tire

By G. Orb

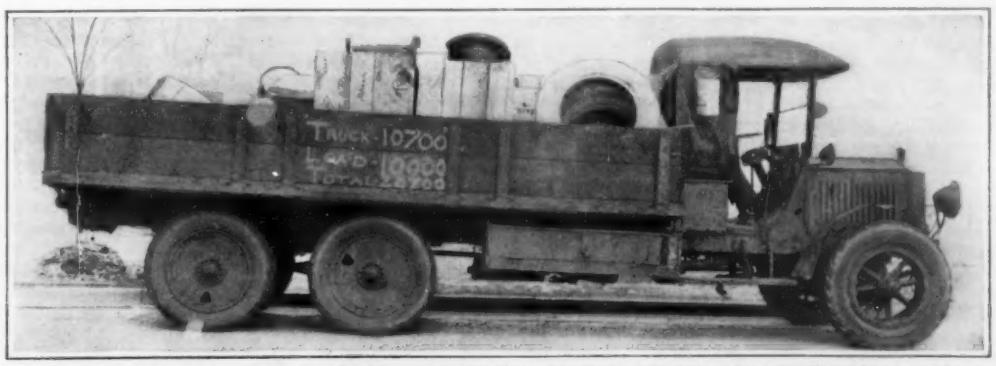
WHAT may prove to be a big step toward a solution of the problem of what will be the ultimate tire equipment for heavy payloads on motor trucks is the recent development of a multiple-wheel truck by engineers of a leading American tire company.

Actual demonstration and close tabulation of results indicate clearly that this six-wheeler, or tandem-axle construction truck, with four pneumatic-equipped rear wheels, has steadier riding qualities, better traction, is less destructive to roads, decreases tire weight and costs, reduces axle weight, has greater braking capacity, and permits greater operating radius.

At a recent meeting of the Cleveland and Detroit sections of the Society of Automotive Engineers, P. W. Litchfield, factory manager of the company in question, expressed the belief that the heavy tonnage truck of the future would be some form of the multiple wheel vehicle, just as the multiple-wheel freight car succeeded the single-truck type in the transportation of heavy loads.

The new six-wheel truck is equipped with four 40 x 8 pneumatic tires (each weighing 119 pounds) in the rear instead of the giant 48 x 12 (weighing about 398 pounds each) used on the 5-ton trucks. This means a reduction of some 279 pounds in weight which the driver on tire changes has to lift; and in addition, the smaller tires cost almost one-third less than the larger ones. The cost of tire investment is further reduced since the eight-inch tire can be used all round on the six-wheel truck and the extra tire can be used as the front wheel spare. Another objection to the 48 x 12 tire, which is entirely overcome by the four smaller tires, is the extremely high center of gravity—the truck load being raised too high off the ground. The new six-wheel construction gives not only a reduction in total tire weight but a material reduction in axle weight as well. Moreover greater braking capacity is attained in the use of four brakes instead of two.

In spite of the fact that the four eight-inch tires have a road-contact area which is 27 per cent greater than that of the two twelve-inch pneumatics, the new truck shows very much better traction qualities. In the tests this was especially noticeable in comparison with dual solids or pneumatics on highly crowned roads and in soft going where additional traction surface kept the wheels from sinking in deeply and the truck from stalling. Increased ease in handling seems to be one of the truck's chief features. With pneumatics on the tandem axle, the six-wheeler seems to cling to the road.



This new six-wheel truck, equipped with pneumatic tires, has been attracting the attention of automotive authorities of late, and may be a big step forward in the art of road transportation

Exploiting the Inventor—II

The Inventors' League: How It Victimizes the Inventor and the Man Who Would Support Invention

By C. H. Claudy

THE inventor of fiction is poor; he is a bad business man; he works in a garret without any facilities; he is hungry and abused and downtrodden generally—until he finally produces the torpedo that makes war impossible, is made president of a great manufacturing company, marries the millionaire's daughter, and throws his enemies into jail.

The inventor of real life is quite different from this. But the pictured and storied trials of inventors have had enough foundation in fact to get across with a kind-hearted and philanthropic public. So when some clever gentleman with a desire for easy money picks upon the inventor as a good financial peg on which to hang his appeal, the public falls for the plan, usually without much difficulty.

Such plans take various forms. The favorite method, however, and the one of most promise, is the "Inventors' Protective Association" or the "Institute of Discovery" or the "Patent Development League"; for an organization bearing such title offers possibilities of playing both ends against the middle by exploiting both the inventor whom it is pretended to aid, and the public with whose money it is pretended to extend aid. The start is made with the public declaration that inventors and invention ought to be encouraged. They ought, in fact, to be encouraged governmentally. Inasmuch as invention is the very foundation of America's wealth, America ought to supply laboratories and workshops and scientific instruments and foundries and machine shops and what-not for the free use of "all inventors having meritorious ideas." By thus helping these inventors to develop their ideas, the Government would add to the wealth and happiness of the country.

Now all this is plausible enough. It is a pretty conception and might indeed be made an actuality were it not for the deep-rooted objection in the mind of the American public to class legislation. However, that is perfectly satisfactory so far as the sponsors of this sort of scheme are concerned. They have no desire to enlist Government support for their ideas. They simply want to be in position to say: "Well, if the United States won't do it, let's do it ourselves." Follows straightway a membership and subscription campaign to get funds to make the "Protective Union" or "Inventors' Academy" or whatever it is called, a success. If you are an inventor you can chip in your little bit and incidentally get the "benefits of membership"; if you are not an inventor or if you are an inventor who has come through the mill and got rich, you can become a patron or a founder or something equally pleasing to your sense of philanthropic achievement by contributing a bit of greater size.

Naturally the general public, which is not composed entirely of fools, hesitates to endorse such a scheme without some guarantee of its genuineness. The promoter knows this; so his first care is to get a lot of big names to support his proposition. The ways in which this is done are various and interesting. A letter is written to prominent men of science, asking whether inventors would not succeed better if a National Bureau of Inventive Research were in existence, capable of doing such-and-such things. The prominent man of science, perhaps, hasn't much time to go into the matter and sends a noncommittal reply to the effect that such an institution would doubtless be of great benefit. "Doubtless" is really one of the most meaningless words in the language, and eminently in its place in such a connection. But forthwith the promoter comes out with the statement "Tomaso Ediconi endorses the Inventor's Protective Association!" Now what the hypothetical Mr. Ediconi endorsed was an *idea*, not a particular expression of that idea; but the public doesn't know that. It says "Oh, if Ediconi is for this thing, it must be all right." Of course all eminent inventors and scientists do not fall for this game; but send out letters to a number of them, and some will surely fall.

Other names are obtained by simply putting their possessors on the Board of Directors, notifying them of the appointment, and printing the name. Still others are got by electing their distinguished wearers "Honorary Members" or "Life Members." When the subject of this delicate attention writes saying "Thank you for this honor," the promoter comes out with "Mr. Westingchurch becomes life member of the Inventors' Protective Association!" It is not difficult to collect a very respectable list of names in these and allied ways, or to put forth literature which seems to make a lot of very eminent personages endorse not only John Jones's idea, but his particular way of putting that idea into effect.

Forthwith Mr. Jones begins his real campaign, directed in two opposite ways at the same time. One object is to get "memberships" from inventors, near-inventors, or would-be inventors—the qualification necessary being nothing more serious than the possession of five or ten dollars to meet the fee; the other is to interest philanthropists and men of means in the Association, and to produce thus subscriptions ranging from a few hundreds to many thousands of dollars.

The securing of subscriptions from inventors is pitifully easy. The association merely advertises itself as prepared to do a great many things it cannot possibly do—things in themselves actually fraudulent. For instance, one such scheme promises to give national publicity "in all United States newspapers and trade journals" to "all meritorious inventions of general public interest, before and after they are patented."

Leaving out of the question the obvious impossibility of anyone's getting publicity in "all newspapers" or "all trade journals," look for a moment at the loophole here made and provided. If any inventor offers an invention for this comprehensive publicity he will be told either that it is not meritorious or not of general public interest. And as to why any inventor should want all this publicity *prior* to the granting of a patent, high heaven only knows—the present scribe does not.

A point made much of in all these schemes is that inventor members who pay the fee of membership, which may be anywhere from five dollars up according to the cupidity of the organizers, may be awarded "certificates of merit" and "diplomas for framing" and "badges of the association." This is held out as an inducement, because such certificates are said to be given only to "very meritorious inventions indeed," and hence will "greatly assist in the sale of the certificated invention or the interesting of capital."

This is buncombe of the rankest kind. There is no capitalist with common sense enough to stay a capitalist who would pay much attention to a certificate of merit given by anybody. A capitalist does not invest in certificates of merit; he invests in and on the advice of his own engineers and chemists and electricians and scientists. No manufacturing concern pays any attention to what some one else thinks of an invention. Its officers know what they can make, what they can sell, what is new and good; all the ornamental certificates in the world would not impress them one iota.

Often more vicious promises are made. One such proposal promises inventors to try to obtain laws which shall punish criminally manufacturers who fabricate any device which may be protected by letters patent. Such a law would of course render anyone liable to criminal prosecution who unwittingly infringed a patented device. This is very catching indeed to Reuben Spade, who invents a new plow, or Hiram Fish, who designes a new shad-net, knowing little and caring less about what is and what is not ethical in invention and laws pertaining to patents. But no greater blow could be struck at industry than such a law. You, let us say, are a manufacturer of ball bearings. You make what you believe to be a much needed improvement in bearings, and proceed to make new bearings according to your invention. Along comes an inventor who has applied for a patent upon a similar idea, and proceeds to put you in jail because you used his patent without his permission. A few such cases, and where would industry be in the putting out of new and better ideas? No one questions that the infringer of a patent should pay for his infringement; but to make a criminal matter of what is not essentially criminal is itself criminal.

Many men, many minds. The association frequently attempts to promise something, however, that shall appeal to all minds. The poor man is inveigled into sending a subscription with a promise to seek laws remitting government patent fees to all who make less than a stated sum per day. Imagine it—that the United States Government should draw a line between the inventor who makes $3.25 a day and the man who makes only $2.90 a day, saying to one "You must pay the fee," and to the other, "Poor fellow, you don't have to pay the fee."

To help "needy members" to secure the services of patent attorneys free of charge is another specious promise. It is a sugar-coated pill; but it is in fact the offer of charity. Free physician's services can be obtained by the needy; free dental service can be obtained by the poor; free clinics and free hospitals and free soup are available for those who cannot pay; why not free patent attorneys?

Perhaps as invidious a promise as any in the list is the declaration that the league or foundation will "put inventors in touch with capital and bring to the notice of manufacturers inventions declared practical by its Scientific Committee." This is pure, unalloyed "bull." No association or academy can do any such thing any better than an inventor can do it for himself. Capital is not the only element needed to make a good invention a commercial success. Capital by itself can do nothing; it requires also business brains. And the business intelligence that manages capital does not need and will not accept the interested advice of any association as to the desirability of the patents of some of its own members—a thing so self-evident that it seems foolish to print it, except for the undoubted fact that no bait is so rotten but that it will catch some kind of fish, sometime.

Enough has been said to show that so far as they are addressed to the inventor the offerings of these "Foundations" and "Institutes" and "Inventors' Development Companies" are directed toward ignorance and hope rather than toward common sense. But when such schemers turn their attention to getting large subscription from philanthropic men with money to spend, they go at the matter from a different angle. They draw elaborate plans for an actual laboratory—get an architect's sketch, a floor plan and a skeleton of an organization. There may be a "Patents Committee," a "General Engineering Committee," a "Chemical," an "Electrical," a "Metallurgical Committee." "Facilities" are to be provided for "worthy inventors" so that they may experiment and "perfect their inventions." The spectacle of a busy hive of inventive industry, in which hundreds of inventors brought from all parts of America are hard at work "experimenting" and "bringing to perfection" their inventions is indeed an inspiring one. Much magnificent oratory is indulged in at dinners, at meetings and in print, as to the "valuable results" which must come from thus "aiding the in-

(Continued on page 406)

THE previous article in this series was devoted to an effort to protect the inventor from the snares that may be set for him by unscrupulous attorneys, sales agents, and unprincipled inventors' insurance companies, under whatever guise these may carry out their schemes. The present installment serves as a warning to the public and the inventor alike, against the traps laid for public and inventor by those who claim to help the inventor to help himself. That such a warning is timely, and that it may be given with the hope that the situation described will improve, is the double significance of the news that comes to us, since the article was written, to the effect that one of the organizations that has been concerned in the formation of a "laboratory for research" has been repudiated by its own Board of Governors. At a recent meeting this Board stated that in its opinion "the purposes of the proposed incorporation having been rendered impossible within the present organization, the Board deem it proper to decline to accept any donations;" and instructions were given to return to the donors such donations as had been made, and also all pledges. In the next and concluding number of the series, Mr. Claudy will say something about the swindles practiced upon the public through the sale of fraudulent inventions.—THE EDITOR.

Succeeding in Electrical Engineering

What This Profession Demands of a Man, and What a Man May Expect of the Profession

By Raymond Francis Yates

FOLLOWING his advice to the young man on how to succeed in chemistry, Mr. Yates now talks to the fellow whose bent inclines him toward electrical engineering. One who has before him the possibility of a career in this field should derive much benefit from the suggestions here put forward. The present article will be followed by others addressed to prospective professional men in various other fields.—THE EDITOR.

NO engineering science has advanced more rapidly than electrical engineering. Fifty years ago electrical engineering was unheard of. The world had just recovered from the shock caused by the development and introduction of Morse's telegraph. A great giant—the electrical genie—was struggling slowly to its feet. First came the practical dynamo (at least it was considered practical in those days) then the electric light, the telephone and traction motor. The most tremendous, the most promising and greatest of all fields of scientific endeavor was slowly opening its portals to those who might care to enter. The colleges, through no choice of their own, were forced to accept pupils for electrical study.

In the year 1889, one Dr. Samuel Sheldon was called to the Polytechnic Institute of Brooklyn to teach electrical engineering. Dr. Sheldon was among the first few men called upon to teach the new science, and during a recent interview he candidly admitted to the author that he at the time knew little or nothing about the subject. In fact there was no such thing as "electrical engineering." There was a lot of disconnected knowledge but this had not been assembled into anything that bore the ear marks of a definite, rock bottom engineering science.

In setting out to find a man who could give him the proper inspiration and put him in possession of the necessary facts for the preparation of this article, the author chose Dr. Sheldon, not only because he is a well-known figure in this field, but because he has had his fingers on the very pulse of the electrical industry since 1889 when he was called to the Polytechnic Institute. Dr. Sheldon is President Emeritus of the American Institute of Electrical Engineers and as an educator he has sent forth into the world many young men full of hope and knowledge. During his interview with Dr. Sheldon, the author was put in possession of the facts included in the following lines:

The electrical field is so vast that it is divided up into a number of very distinct engineering branches. Like every other field that develops, the day arrives when the specialist comes into his own. Every year seems to bring with it a new field of specialization in the electrical industry. The electrical engineer is no longer a Jack-of-all-trades. We have traction engineers, power plant engineers, meter engineers, transmission line engineers, railway signal engineers, research engineers, illuminating engineers, motor engineers and telephone and telegraph engineers. Each one of these branches is a distinct field in itself and offers occupation with very rich reward to those who specialize in them. Some of the fields mentioned above are so important that the author has decided to treat them as separate professions.

The electrical traction engineer is one who is concerned with electric railways and their development, management and operation. The electrification of railways is taking place at a tremendous speed. A few years ago the great Grand Central station in New York City was beclouded with smoke and soot from the hundreds of steam locomotives which came and went daily. Then came the electrification of the lines running into the Grand Central. Today this station is the very symbol of cleanliness. Huge electric locomotives glide swiftly and silently over the rails, leaving no trace of smoke or ashes. As great as the field of electric traction is today it can be said that it is still in its infancy.

With the electrification of numerous power plants, sub-stations and converter stations throughout the country, there has been developed a need for men who are experts in the measurement of electricity. This has brought to the front a new field called meter engineering, and men are now being educated along this line entirely and they are concerned only with the development, perfection, installation and operation of electric measuring instruments. Measuring electric current is one of the most important branches of the electrical industry.

With the development of great sources of water power such as Niagara the necessity of economically transmitting this power great distances was brought about. It was found most practical to first raise the voltage and then "step" it down again at its destination. The many problems and phenomena associated with high tension transmission made room for men who had specialized in this work and today the field is in need of transmission line engineers.

It was but a few years ago that electrical signaling was introduced on railroads. Today it forms an important branch of electrical engineering which has just started to develop. During the government operation of the railroads, government experts saw the need, as never before, for an automatic signal system that would stop trains when they passed through blocks, etc. Such systems are now being developed and when the time of their universal application arrives there will be tremendous opportunities for men who have specialized in this line.

The research electrical engineer is a man of high training. He must have a great mass of theoretical

(Continued on page 403)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Why Metazoa Die

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of Nov. 15, 1919, the question is raised why metazoa are mortal while protozoa are immortal. On page 500 the writer of the article answers her own query as follows: "The answer is that if there is nothing in the protozoa itself, [sic] to challenge its capacity to live endlessly, something may be introduced. The immortal may be reduced to mortality by poison, by extreme heat or cold. . . . Is it some such secondary cause . . . which interferes sooner or later with the functioning of the many-celled metazoa?"

Of course poisons and extreme heat or cold are responsible for the death of many metazoa, but that explanation fails to account for the preordained death of all organic matter however well protected from poison, heat or cold. The explanation must be sought elsewhere. Stated as briefly as possible, it is this: Protozoa are simple, homogeneous, and stable; metazoa are complex, heterogeneous and therefore unstable. The protozoon is a simple cell, the vital unit of all life, multiplying usually by fission; the metazoon multiplies by some form of germination or ovulation. The metazoon is a complex of cells with chemical elements and compounds, all forced into artificial associations from which they strive in every way to escape with all the urgency of their inherent repulsions and attractions. Just so soon as the force which has coerced them into those artificial relations relaxes or fails they fly apart and satisfy their natural affinities. That is the true explanation of the inevitable death of all metazoa.

In order to see a perfect illustration of all molecular and atomic affinities satisfied we have only to look at our moon. On her sepulchral surface no particle whatever struggles to free itself from the grasp of some repulsive partner and to fly to the embrace of its affinity; all is perfect peace, serenity and death. Some time earth may reach the same blissful state, but at the present writing our little planet is the arena of fierce rending, and infinitely complex conflict and has been, ever since the first metazoa made their appearance.

What is that conflict? As already stated, it is the conflict between certain mighty forces and the molecules and atoms which they are continually driving into artificial or unnatural relations. The triumph of those forces furnishes the phenomena which we call life; the final triumph of the rebellious elements we call degeneration, death, and decay. It is a law of the Universe that the simple endures, the complex tends to break down because of its very complexity. That law holds good in politics, economics, mechanics and society, just as in the world of plants and animals.

It remains to consider the mighty forces whose interference with natural tendencies and affinities causes that continual uplift of matter which is called life and which is the first essential of any kind of evolution. All other forces work for the extinction of both protozoa and metazoa. If that interference should cease all attractions would soon be satisfied; earth would be only a dead planet whirling through space laden with nothing but the dead.

Those interfering forces are twins, each incapable of producing living things without the other, but in combination they work wonders—the sun and the vital force. The sun's kinetic rays lift billions of tons of water into the skies against the attraction of gravitation and as soon as that compulsion ceases they rush back in rains and rivers. But mighty as is the sun he cannot create a single living thing; his utmost is to furnish the right conditions for vital force to act. That strangest most mysterious force of all works at first in the secrecy and darkness of the matrix, compelling reluctant molecules and atoms into organic compounds, molding and fashioning the miracle of the unborn until the time is ripe for bringing it into the light of day and under the action of the sun's actinic ray. Of its nature and mode of action we know even less than of the sun, we can only observe and marvel.

I am well aware that some deny the existence of any vital force. Very good. Then it is their privilege and duty to supply a better hypothesis. For they know right well that, with all the resources of chemical and electrical science at their command and with the sun to help them, they cannot create a single living organism, or even the seed of one. However cunningly they may put together all the chemical components of any organism, it will always remain dead matter unless they add in some form the one thing needful—vital force. Not scientific? Just as scientific as the atomic theory or the nebular hypothesis.

So far in our broad biologic survey of this subject we can be fairly scientific, although with many sad deficiencies in our scientific knowledge; but now we come flat against a great wall of mystery which science has never been able to penetrate or surmount. What is the nature of those great twin forces which, working together make dead matter live, and what are the secrets of their action? Science can only cover her face and cry "I do not know; I cannot tell."

Then faith comes and takes science by the hand, saying—vital force, solar energy, gravitation, chemical, electrical and magnetic attractions and repulsions are all diverse manifestations of one omnipotence and omniscience which energizes the whole universe, assigning to each species of plant and animal its allotted span of life. In all ages many men have given many names and many descriptions to that first great Cause, but the best name is God. R. W. CONANT, M.D.

Chicago.

A Rocket Flying Machine

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in the article appearing in your issue of February 14, describing Dr. Goddard's rocket for exploring the upper atmosphere.

It reminds of a dream that I have had ever since boyhood school days, of a flying machine working on the rocket principle, but utilizing the enormous velocities of "radiant" matter to give the required kick. Such a machine would be easily controlled by changing the direction of discharge, by augmenting it or shutting it off at will; it would require small space; in short it would be *the* efficient machine.

I am not enough of a specialist in atomic or radiant physics to speak for the practicability (present or future) of such a scheme, being merely an engineer. But I have gone to some extent into the theory and design of the mechanical parts. Anyone who is equipped with the requisite scientific knowledge is welcome to the idea. LEO G. HALL.

New York.

Left: Open wire work-benches with blowers for the enamelling room, with its heavy fumes. *Right:* One day's accumulation of dust which would have polluted the atmosphere of the polishing room had there been no provision for carrying it away

The worker's lungs must be protected, as well as his limbs

How Much Is a Worker Worth?

Safety Appliances and Methods in American Factories That Throw Light Upon This Question

By David Harold Colcord

INDUSTRIAL accidents are a modern development. Accidents in the early times were the result of physical phenomena and of wars; there were no industrial hazards. Today we are trying to reduce industry's heavy toll of human life. Many pessimistic souls would have us believe that the attempt is made to prevent accidents merely because it is cheaper to prevent them than to have them. Be that as it may, no one can question that a notable feature of the past ten years in industry has been the progress made toward eliminating the unnecessary casualty. This is the story that Mr. Colcord has to tell.—THE EDITOR.

IN the early times, there were no industrial hazards. Accidents were the result largely of physical phenomena and wars. Today, with the adoption of labor-saving machinery and the migration of the population to congested urban centers, the very effort to produce commodities to sustain life, jeopardizes life in direct proportion to that effort.

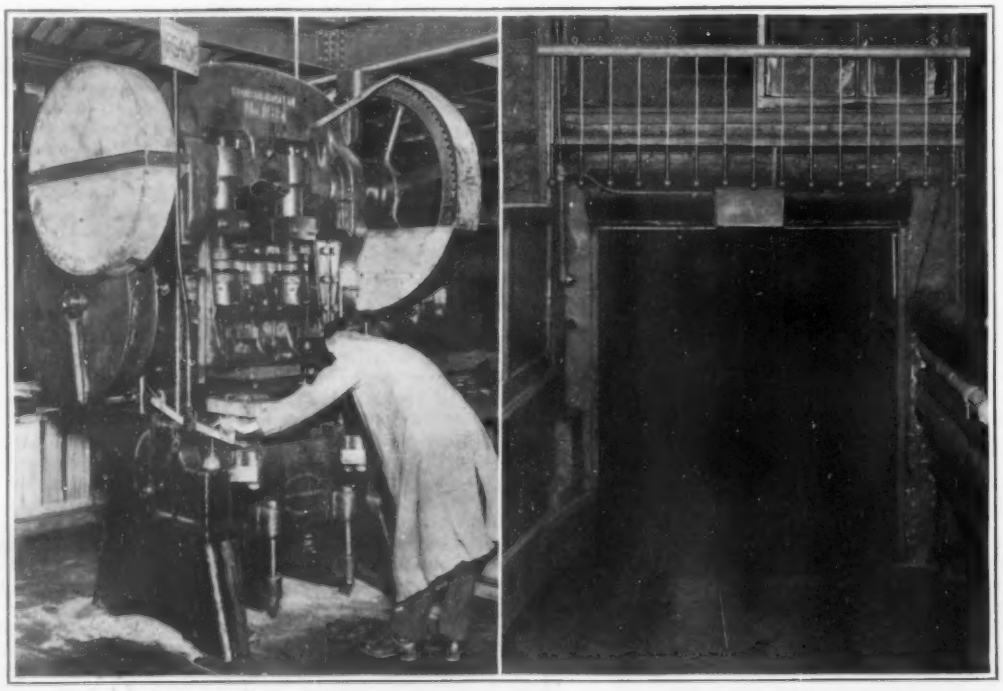
Perhaps the first scientific and successful effort to prevent human suffering entailed by accidents was the safety pin. Since then husbands have slept better nights, and babies have better dispositions even though their lung development has been discouraged thereby. Perhaps effective safety propaganda began too, with the pin-pricked baby.

One hundred and sixty-five children were burned to death in a Cleveland public school fire a few years ago. Here was a loss of life due to carelessness. The Cleveland fire was a "red rash," localizing a national disease of carelessness, eventually directing the way to scientific and effective treatment. There is scarcely a public school in the United States today that is not absolutely safe for our children. Imagine each one of these 165 children burned to death separately and on different days in 165 different towns scattered from Maine to California. Would we even have noticed the loss? Would not the very indefiniteness of the building ills have baffled diagnosis and treatment? Any great disaster jars our sensibilities in a marked degree. Everyone remembers the glaring headlines that told us of the Iroquois fire, the San Francisco earthquake, the Galveston flood, or the sinking of the Titanic, and yet industry and commerce kill and maim more victims every month of the year than met death in all of these catastrophies combined. The difference is that we sense its seriousness only when it occurs wholesale.

Over 1,600 human beings are killed and injured in the United States daily and a large percentage by our industrials. The problem of protecting human life in the industrial work shop of the world is of as vital importance as the problem of preventing war—and it is a thousand times more essential that the problem be kept glaringly before the American people because war is spectacular, and accidents have become nauseatingly commonplace.

Sixty million men fought in the Great War, a little more than half as many people as live in our United States. Seven million of these men that fought are now dead, six million permanently injured. Yet during an average man's productive life, industry in the United States takes an equivalent toll. The United States mobilized over 4,000,000 men; 67,813 are now dead and 192,483 were seriously wounded. Yet in peace time in the United States as many individuals are victims of accidents in six months. Seventy-five per cent of these are preventable. Industry injures one-half million men annually and 20,000 of these are fatal accidents. In addition to the loss of life and suffering, the economical waste entailed is considerable, being estimated as a loss of 105,000,000 working days or 350,000 years of 300 week days each.

To kill a man means that a green employee must be broken in to take his place at an estimated loss of an initial $75. Besides the amount required as compensation to the dependents of the victim usually runs into four figures. Again the destructive effect of the accident lowers the morale of men in the plant which has in times of decreased efficiency, a measurable momentary value. Furthermore, it is exceedingly difficult to replace men—any employer has realized that in the past five years.



Left: It is the left hand that gets caught in punch-presses: so this press has a safety control that is operated by that hand instead of by the foot. If the hand is on the control it can't be in the press. *Right:* Drivers of electric trucks in the tunnels that pass from building to building in this factory are warned of the approaching low-bridge by a series of hanging balls similar to those seen on the railroads

Interesting devices for accident prevention in the factory

Electricity Becoming the Dominant Hazard

The energy of the future will be electrical. Giant turbines are today generating unthinkable power and are already spreading their network over the industrial centers, feeding the factory and the home. In a measure the hazards that accom-

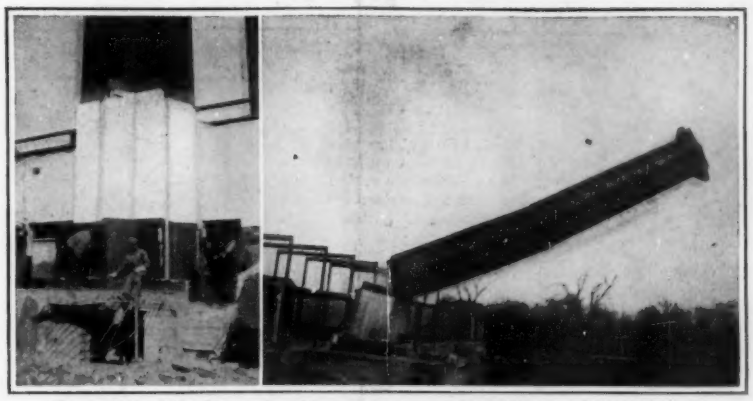
(*Continued on page 409*)

Felling a Chimney by Fire

IT frequently becomes necessary in construction work to wreck a perfectly good existing structure in order to make room for a new one. A case of this nature recently occurred in Elizabeth, New Jersey, in connection with the erection of a giant automobile factory. To make room for this factory, it was necessary to wreck a practically new industrial building which had been built for war purposes, but which was never used on account of the early signing of the armistice. A part of the wrecking of this building consisted in the felling of two eighty-five foot brick chimneys which were a part of it. An unusual photograph shows one of these stacks in the act of toppling over.

The reinforced concrete base of the stack was first cut away by the use of chisels, hacksaws and hammers: the concrete being replaced as fast as cut away by heavy timber bracing, to prevent premature falling. When all was ready, a quantity of fine kindling was piled against the bracing timbers and the whole set on fire. In thirty minutes, the fire had weakened the timbers sufficiently to permit falling, with the results shown in the picture. The stack struck the ground exactly in the place planned beforehand.

It is interesting to note the way in which centrifugal force, combined with the resistance of the air to the rapidly moving top, has begun to pull the brickwork apart while still in midair. A second similar stack, felled a few days later, broke into four nearly equal parts before striking the ground.—By *Leo G. Hall.*



Near view of the base of a chimney prepared for felling, and the chimney caught in the act of falling

From Destruction to Construction

JUST how many tanks Germany constructed during the last days of war, nobody knows except the former German military leaders—and they are not around to answer this question. However, for a certainty the German tanks failed miserably on the battlefields, because of their extreme weight and poor mobility.

But the story in this case has to do with the peaceful use of the German tank. In the accompanying view we have a former German tank being used in the streets of Berlin for the transportation of structural steel and other heavy building materials. With the armored body removed and with other slight changes, the German tanks are being used in fair numbers for this and other utilitarian purposes.

An erstwhile German battle tank transformed into a peaceful carrier of building materials

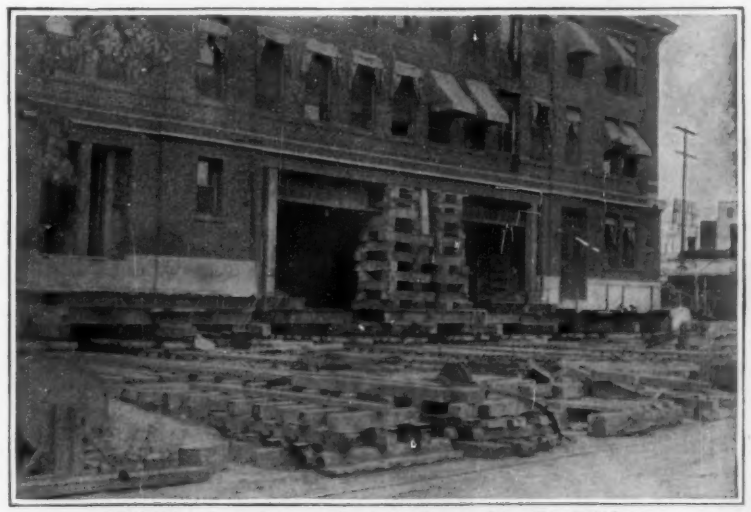
Moving a Three-Story Building with Business as Usual

WHAT engineers consider to be one of the greatest feats of the age was accomplished by L. P. Friestedt of Chicago and New York, when his organization moved a reinforced concrete building a distance of 450 feet to make room for the new, large office building to be constructed for a large automobile company in Detroit.

The structure moved is three stories high and is occupied as an office building. It was a question of either tearing it down or moving it. Inasmuch as it was practically new, the razing of it was considered almost shameful, so its removal was decided upon. The proposed site required the crossing of a street on which a car line traveled. This necessitated the cutting of trolley wires and telephone cables.

During the entire period of moving—six days—business was not suspended a minute; telephone communication was uninterrupted and business continued as usual.

Three electric motors were pressed into service for the task. The building measures 60 x 95 feet and weighs approximately 3,000 tons unoccupied.—By *C. J. Shower.*



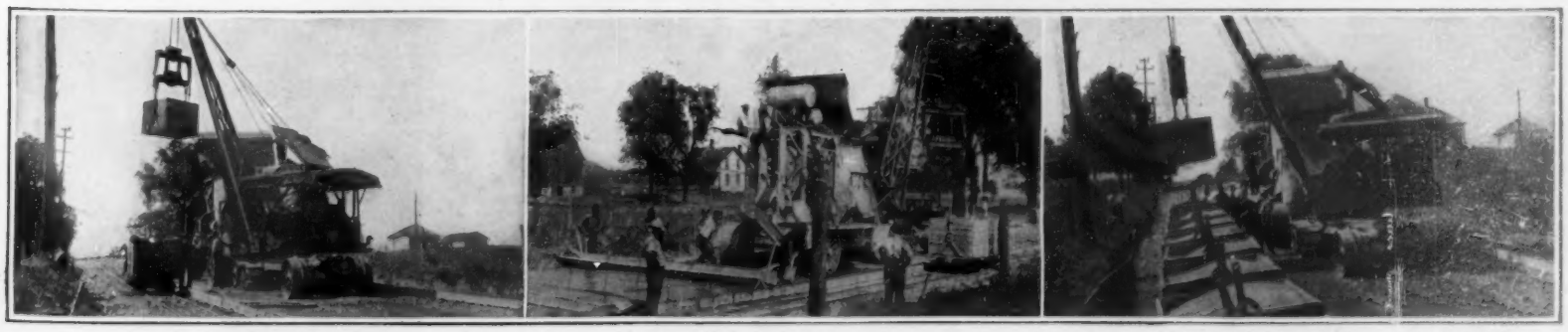
Without a single interruption in business, this office building was moved across the street

Every Week a Mile of Concrete Road

WITH the ever-increasing interest in the necessity of building good roads there comes the effort to build them good and fast. With the special equipment that a Michigan contractor is using concrete roads are constructed at the rate of a mile a week.

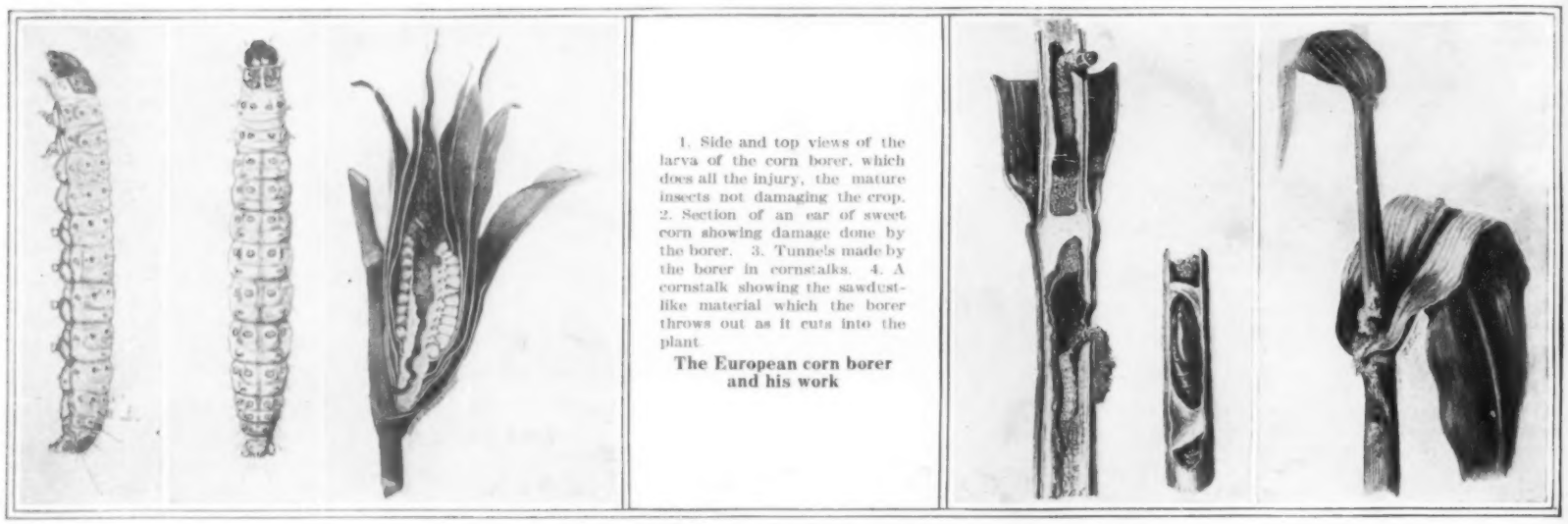
To aid the process of rapid building the contractor effected a simple and highly practical scheme for handling materials used in paving. Not far from the road surface where the concrete was being poured was located a large yard for the storage of rock, sand and cement. With specially constructed switching facilities the materials were taken from the main line of the railroad as shipped in and stored for future use or taken directly to the work in progress. The cars at the material yard were unloaded by a locomotive crane situated on a flat car. This system enabled the cars of material to be unloaded at various places in the yard without undue switching of the cars. A narrow gage track led from the material yard to the location of the mixer. Trains of 15 cars of the small industrial type operated between the mixer and the material yard. Each car in this train carried a large batch box accommodating enough of the material for one charging of the mixer's hopper. The batch box had a capacity of approximately 55 cubic feet. At the material yard the proper amount of rock was placed in the batch box and the train proceeded to the cement hopper. The cement was measured through a metal cylinder into the batch box. The metal cylinder holds 5 cubic feet of cement and is arranged so that it could be filled and emptied until the proper amount of cement was added to the rock. At the sand hopper the proper amount of sand was added to the batch and a gasoline locomotive hustled the train off to the mixer. The aggregate in each batch box weighed over two tons.

Upon arriving at the mixer a two-drum power crane picked the batch boxes off their cars and swung them up over the mixer. The picking up of the boxes by irons attached to the door, swinging them into place and then the releasing of this line and the picking up of the line attached to the side of the box, thereby dumping the contents into the charging hopper of the mixer, is made possible by a steel bridle formed of channels and I-beams. This crane furnished the traction for the mixer by operating on caterpillars and moving under its own power. A constant distance between the crane and mixer was maintained by a rigid attachment.—By *Allen P. Child.*



Position of crane and mixer — The mixer in operation — String of batch boxes being loaded

Methods employed by a Michigan contractor to expedite concrete road building



1. Side and top views of the larva of the corn borer, which does all the injury, the mature insects not damaging the crop. 2. Section of an ear of sweet corn showing damage done by the borer. 3. Tunnels made by the borer in cornstalks. 4. A cornstalk showing the sawdust-like material which the borer throws out as it cuts into the plant.

The European corn borer and his work

Fighting Plant Pests With Fire

The European Corn Borer and the Way in Which It Is Planned to Banish Him from America

By R. P. Crawford and G. H. Dacy

EPIDEMICS that attack human beings are not the only kind that modern science studies and controls. Where once little intelligent defense could be made against insect pests that attack the crops, today we bring to bear on these creatures all the force of scientific method. We study their life cycles in the effort to find their vulnerable spot, and we make a concerted effort to dispose of them once for all. In the recent visitation of corn borers from Europe excellent illustration is found of this, as will be seen in the story told by Mr. Crawford and Mr. Dacy.—THE EDITOR.

CORN growers of the country are much disturbed over the possible spread of the European corn borer which has already become a formidable crop pest in Massachusetts and New York. Entomologists and crop experts of the country are somewhat divided as to the possibility of its further spread and destruction of the corn crop in the Mississippi Valley. Should the pest get a good start in the Corn Belt of the country, it might do untold damage. Already states in the Middle West are passing embargoes against the shipment of certain agricultural products from the infested districts in the hope that its spread can be stayed. However, there is a possibility that it may have already secured a start in that section and future seasons may bring it to light.

Almost since the inception of corn cropping abroad, the European borer has been the most objectionable pest which has attacked not only corn but also millet, hops and hemp throughout Europe and Asia where these crops are grown. As a consequence of the heavy toll and persistent damage which this pestiferous insect has accomplished overseas, it is stigmatized as being one of the most injurious plant plagues ever introduced to America. The first discovery of the European corn borer in this country was made near Boston in 1917. The area then infested comprised about 100 square miles. The following season it had grown to 320 square miles, while in the summer of 1919 over 2,750 square miles were found to be infested by the pest, and it had spread into both New Hampshire and New York. Both the states of New York and Massachusetts have made appropriations for combating it and the Federal Government is also trying to prevent its further spread. The season of 1920 may show whether the pest will spread farther westward or confine itself to the East.

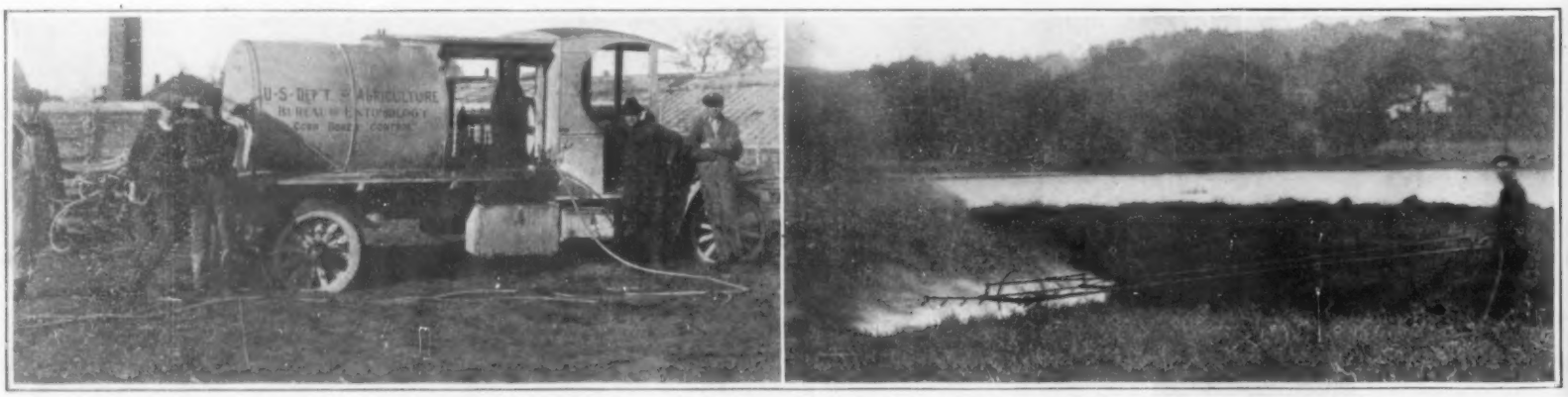
The corn borer is believed to have been brought to this country in shipments of broom corn from Europe to factories near Boston. The damage is done by the borers making tunnels through the stalks of the corn plants and even into the ears. The borers usually begin by entering the stalk near the base of the tassel and working upward until the tassel topples over, one of the characteristics of the European corn borer. Sawdust-like material at places where the stalks have been broken open are among the indications of the presence of the pest. A single corn plant in Massachusetts was found to be infested with 117 borers. One entomologist has estimated that a badly infested area will have over a million borers per acre.

In Massachusetts there are two generations of the corn borer per year, the borer spending its winter in the corn stalks and old plants. When warm weather develops in the mid-spring season, the borers resume their destructive operations after their Rip Van Winkle-like sleep and usually eat so ravenously that by the middle of May they are full grown. About this time, the borers tunnel exits to the surface of the ears of corn or other material in which they have been residing and then close these holes with silk-like partitions which they spin. They then retire to the most remote part of their respective residences, spin thin cocoons of silk and change into the pupa or resting stage.

About the first of June the adult moths emerge from these quarters. In this stage

(Continued on page 411)

Small hand-burner for working around fence corners and other tight places



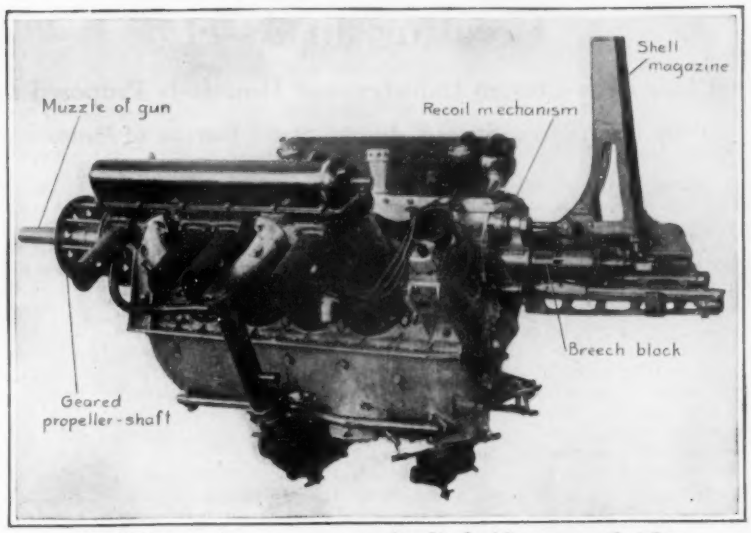
Left: Oil tank and pressure apparatus for burning off the infected straw and crop refuse. From this tank fuel is piped by rubber hose to the two-wheeled carts that carry the flame about the field. *Right:* Manipulating the small cart that does the actual burning.

Some details of the flame campaign against the corn borer

Firing a Cannon Through a Propeller

Of the many things that were developed to a practical stage just a bit too late to participate in the great war is the cannon firing through the propeller. Already the designers of the Hispano-Suiza airplane engine had realized an engine mounting a Lewis gun firing through the hollow propeller shaft; but the problem of mounting a cannon called for considerable mechanical skill.

The accompanying illustration depicts the "airplane motor cannon," as developed by the designers of the American Hispano-Suiza motor, for the use of the United States Army. The jacket of the new 1½-inch cannon fits in the propeller shaft through which it sends its armor-piercing projectiles. The various parts of the novel motor cannon are indicated in the illustration.



The airplane motor cannon—an engine fitted with a cannon that fires through the propeller shaft

When Motor Trucks Drive the Shop Machinery

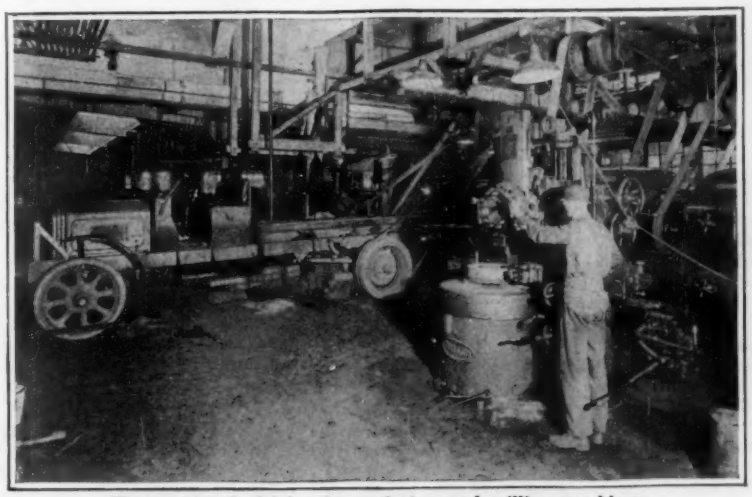
THE motor truck has won new laurels. This time it has scored in the field of motive power for shops and factories which would otherwise be rendered inoperative by the shortage of coal.

The first of the accompanying illustrations represents two standard 1½-ton truck power plants operating an air compressor in a motor truck factory. The air compressor requires about 75 horse-power when working. It is equipped with an "unloading" device which throws the cylinders out of operation whenever the air pressure reaches a predetermined point. When running idle in this way the air compressor requires some five or six horse-power only; but the moment the pressure drops the cylinders are again put to work, calling for a sudden change of from 6 to 75 horse-power in the driving power.

The two engines shown driving the air compressor were taken out of stock and were not limbered up or adjusted in any way. They were rigged up on test stands, as shown, and belted to the air compressor. They are shown running at a speed of about 1,200 revolutions per minute, and had been operating in this manner for several weeks when photographed.

The same motor truck plant made use of its standard five-ton trucks for driving other machinery during the coal famine. These trucks were installed in various parts of the plant, with their front wheels blocked, rear wheels and axles jacked up, and belts attached to the rear wheels as shown in the second illustration. These trucks furnished power to big lathes and heavy milling machines; in fact, it was found that the trucks delivered more power than the regular motive power equipment. The radiators on the trucks did not get hot; indeed, one could place one's hands on the radiators even after a steady full-load run of 30 hours.

Little gasoline tractors also did good work in a gear plant, as shown in the third illustration. A "shop mule" is here seen driving a number of machines through a belt drive on the rear wheels. The exhaust gases are carried away by heavy piping.



Five-ton truck driving heavy lathes and milling machines in place of electric motors

Copyright, Keystone View Co.

"Shop mule" driving heavy machinery during the coal shortage

Calendar Reform in Roumania

THE Roumanian Government has adopted the Gregorian calendar, the change taking effect April 1, 1919. The ecclesiastical authorities in Roumania continue, however, to use the Julian calendar.

Front Brakes Gaining

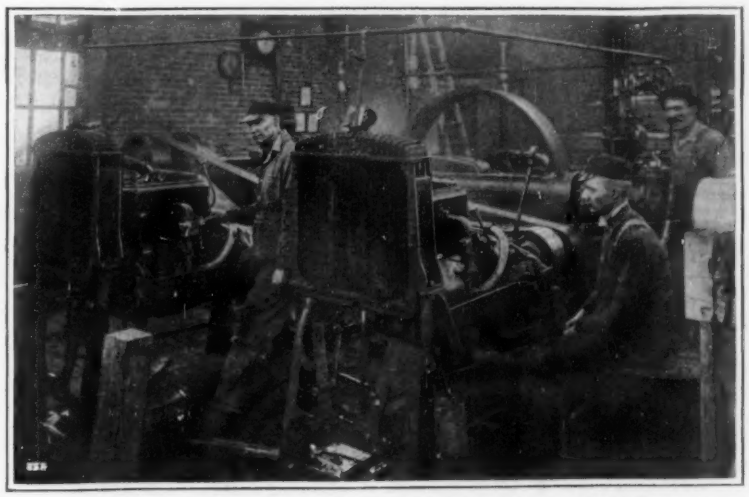
FROM reports concerning the Paris Show, the front wheel brake seems to be gaining in popularity abroad. This is a feature that has been exploited with considerable success by various European manufacturers but has not been used by any American maker. It is a costly construction and would be used only on the most expensive of the high grade cars.

The front brake may be considered from two aspects. If used in conjunction with rear brakes, the weight of the entire chassis is available for brake adherence. There is less danger of the wheels being locked by the brakes which results in excessive wear to tires and, of course, the car can be brought to a stop in a shorter distance, because of the greater retarding effect. If both sets of brakes are used at the same time, the strains due to braking are reduced and trouble from overheating the brake bands is minimized.

The front brake is specially attractive because of its anti-skidding quality. All motorists are familiar with the fact that the application of the rear brakes while the car is running over a slippery road, and especially when running down hill, tends to cause skidding. The reason is that a greasy road surface permits the wheels to be easily locked by the brakes, and locked wheels move as easily to the side as in any other direction, especially if the tires are properly inflated.

When motion of the front wheels is arrested there is no skidding, because the rear wheels have a steadying action similar to that of the tail of an airplane. When the rear wheels are locked it requires only a slight dislocation of the center of resistance to start the car skidding. The propulsive effort is generally centered around the axis of the chassis, and as long as the center of resistance coincides with it everything goes well. But let one of the front wheels strike an obstruction or pot hole, so as to unbalance the resistance, and a skid is started.

From a safety standpoint the front wheel brake is certainly a desirable feature though it introduces an item of mechanical complication that will not be welcomed by the man who takes all the care of his own car.



Two 1½ horse-power motor truck power plants running an air compressor during coal famine

Building with Cinders

THAT the World War stimulated the inventive forces of industrial, engineering and chemical activities is an acknowledged fact as manifested by innumerable concrete illustrations. Did you ever hear of a town built exclusively of coal cinders? Well, the exigencies of the world conflict which devised methods of converting decayed peach stones into gas masks likewise gave the U. S. A., "Cindertown," Delaware. The two examples are not of equal consequence, but both are fruits of inventive skill prompted by emergencies.

Building material was not available and transportation agencies were taxed to staggering proportions, when the Overlook Colony, located seven miles north of Wilmington, Del., was confronted with the problem of inadequate housing for workers employed in a munition-manufacturing plant. An increased force of operatives was imperative, otherwise there would have been a slowing down of the machinery in supplying ammunition for a cause that ultimately proved victorious. What then seemed a remote substitute for concrete was a super-abundance of coal cinders, merely an accumulation of waste products from a mammoth industrial plant. Quick decision was essential; speed was paramount in the production of munitions. Engineers and architects vied in the consideration of the knotty questions . . . would cement and cinders mix in the construction of building walls; would the unburnt sulphur in cinders exercise a deteriorating effect on cement mixture?

A block of cinders and cement was made and put to a test of strength, the substance developing rare stability. Only when subjected to a pressure of 1800 pounds to the square inch was there evidence of crumbling, which is 1680 pounds in excess of the usual carrying capacity of a dwelling or light building wall. The test was a

(Continued on page 412)

Creating an Asset

Scientific Work That Has Been Lost to Industry, and How It Is Proposed to Make It Available

By Dr. Andrew Stewart, United States Bureau of Mines

FOLLOWING the paralysis of industrial production and consequent depletion of the world's goods caused by the war, these must be the days of casting about as never before for ways and means of exploring and conserving natural resources, of seeking for better, more economical methods of doing things, of preventing wastages and of turning them into useful by-products.

This country, so vast, so favored above others, so replete with every bounty within Nature's gift, has heretofore been looked upon by its easy-going people as a source of raw materials that could never be exhausted. That this is a delusion has been demonstrated by the tragedy of war, culminating in destruction so swift and unparalleled that all Europe has been plunged in want and our own reserves of all sorts have been appallingly consumed. A real pinch of necessity has arisen among us, sending the cost of living soaring to the breaking point, so that we are now rudely waking up to the fact that we must stop squandering our patrimony with no thought of a tomorrow, stop going about with a blunderbuss taking pot shots at the goose that laid for us the golden eggs of plenty, and exert ourselves to the utmost to conserve our natural wealth and to make it go as far as possible by continually seeking out and applying improvements in the processes and machinery of production to increase output and to minimize loss. Therefore, the rôle of the inventor, in the economy of the world, always most important, has now become paramountly so. It may be said that upon him mainly rests the future salvation of the human race, and anything that will properly encourage him, stimulate his genius, and promote the successful application of his creations is a direct step toward that end.

It is in this connection that it is desired to call attention here to the fact that hitherto a most valuable by-product of the Government's activities, in the form of inventions and of scientific data capable of being developed into inventions, has been allowed to go largely to waste for want of translation into industrial use. It is undoubtedly not realized by the public how great and actual an asset for the nation this can be made.

A recent report by the Director of the Bureau of Standards, of the Department of Commerce, reviewing the work of that Bureau for the year ending June 30, 1919, includes a list of the special researches and lines of testing there carried out. The bare enumeration of these occupies the space of twelve pages. It is disclosed in the report that there are 64 scientific and technical sections and 20 clerical, construction and operating sections in the Bureau; that during the year it issued 51 original and 36 reprint publications, and that in its several laboratories more than 131,000 tests were made. A very significant event of the year was the completion of a great industrial laboratory for research in testing structural materials. Included in this is equipment affording facilities for general research and especially for research along the line of developing new clay products.

This is but one example of the Government's immense scientific activities. In the many diversified laboratories of the Department of Agriculture and the Geological Survey; in the eleven splendidly equipped scientific experiment stations of the Bureau of Mines distributed over the country, and in the technical bureaus of the War and Navy Departments and other departments of the Government, there is constantly in progress research work comprehending the whole range of scientific knowledge and experience. And in allied fields, comprising the technical departments of several hundred colleges and universities in the country, and the many richly endowed foundations for the advancement of civilization through research, a most prolific yield of scientific data, having immense possibilities for invention, is yearly brought forth.

As Prof. Milliken of the University of Chicago, formerly Lieutenant-Colonel of the Signal Corps and Chief of the Science and Research Division of the National Research Council, has pointed out, the inventive ingenuity of the country, stimulated by the exigencies of the war, was, under Government control, given an impetus far exceeding all precedent, and while the prime object of this was the production of munitions and weapons of war, it yielded a most valuable by-product in devices and processes applicable to the pursuits and needs of peace. For example, the sound-ranging devices for locating enemy submarines can be developed and used to afford complete protection to fog-bound vessels against collision at sea. The imagination is stirred by the possibilities here presented of saving valuable human lives and treasure. Again, aerial photography was so perfected for military purposes that with it a system of land surveying has been devised that will revolutionize the art, cutting down time and expense and making the survey of hitherto inaccessive places easy.

But the great mass of scientific material evolved as indicated above, while of the utmost academic interest and value, has been put to comparatively little practical use in industry, because the instrumentality for effecting this translation has always been lacking.

The status of the inventor in the Government service who wishes to develop his invention by patenting and commercially utilizing it has always been an ambiguous one. Widely different views have been held by officials in authority as to the inventor's rights and obligations in the premises, and questions of ethics have often arisen. Broadly stated, the relation of the Government employee to the Government, in the matter of patents (except in the case of employees of the Patent Office), is in law the same as that of any employee to his employer, but this status has, from time to time, been differently interpreted by heads of bureaus and departments, and various restrictions have been placed upon the patenting of inventions evolved in the service, so that an anomalous state, confusing and discouraging to the inventor, has resulted.

Even in cases where inventions have been perfected and patented and have been subjected to no restrictions, but where it has been the desire of the inventors to assign them to the Government in the interest of the public, there has been no legally constituted way of doing this, because no Government official or agency has been authorized by law either to accept assignment of patents or to administer them. Scientific men and inventors are notoriously deficient in business training, capacity and inclination, so that administration of their inventions and patents by themselves has rarely been successful. It has been attempted to make the patents of employees of the Government, and those of scientific institutions and of philanthropic private inventors, available to industry in general by direct dedication to the public, but this has always failed of its object, because an invention covered by a patent so dedicated does not interest the capital necessary for successful industrial development, and because it may be excluded from public use by patents subsequently taken out by others.

A further point which should be mentioned in the discussion of this subject is that the Government inventor is justified in expecting some material benefit to accrue to himself from the successful operation of his peculiar talent, this being the case with inventors in outside employment. In the latter field it has been proven to be good business to encourage inventive thought by rewarding the creators of profitable inventions in different ways, either by awards of money, as bonuses, or by promotion, or by gifts of shares of stock, etc. There is nothing analogous to this in the Government service.

The above considerations have been set out in some detail to emphasize the fact, already established, that there has always existed an obstacle in the way of industrial development and application of inventions and of scientific ideas evolved in the Government service, and of those of certain types of outside inventors. To remove this obstacle the machinery for making such inventions commercially available has at last been provided in the following measure, which is now before both houses of Congress, being identical bills S. 3223 and H. R. 9932:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Federal Trade Commission be, and hereby is, authorized and empowered to accept assignment of, or license or other rights or powers under, to develop, to issue or refuse to issue licenses under, to encourage the industrial use and application of, and otherwise to administer, on behalf of the United States, under such regulations, and in such manner as the President shall prescribe, inventions, patents, and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by employees of the various department or other establishments of the Government, or by other individuals or agencies; and to coöperate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out.

"Sec. 2. That the Federal Trade Commission be, and is hereby, authorized and empowered to collect fees and royalties for licensing said inventions, patents, and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited a certain per centum, to be determined by the President, shall be reserved, set aside and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents, and patent rights contemplated by this Act as may prove meritorious and of public benefit.

"Sec. 3. That the Commissioner of Patents is hereby directed to grant all patents and record all assignments and licenses contemplated by this Act without the payment of any fee."

It will be observed that there is absolutely nothing mandatory about this measure. It is purely permissive. It simply confers authority to try out an experiment in practical economics, which, if successful, will add a great industrial asset to the country, and which, if unsuccessful, will eliminate itself, because no more patents for administration under it will be forthcoming. Under its provisions the status of the Government inventor will be clearly established and he will be encouraged and stimulated to greater inventive effort, because he will receive full credit and some recompense for his successful creative work, while relieved of all trouble and expense in its development and administration.

The Government benefits through having an impetus imparted to inventive production among its workers, the satisfactory control it maintains thereof, and the opportunity thus presented for research in a new field of practical economics by the study of the working of patents in the interest of the public.

Probably most pronounced and direct, however, will be the advantage to industry. It, and therefore the public at large, will be the ultimate beneficiaries of all the good this bill will bring about, through the practical adaptation of the research data and inventive talent within the Government service to the needs of the business world. Where before the capital to develop the inventions of Government employees could not be interested, since seldom or never could complete control of the invention be assured those who might develop it, now the patent may be so handled as to eliminate this drawback. And just so much will production, never so vitally important as now, be advanced, bringing in its wake its concommitants, better living conditions and augmented prosperity.

THIS is a conservative old world—it does not like to change its ways of doing things, but has to be pushed and prodded into anything new. This is one reason for having a patent system—aside from the fairness of the thing, the only way to insure that an invention will be pushed upon an unwilling world is to give somebody a monopoly over it for a time long enough to make its exploitation pay. Nobody is going to push an invention, nobody is going to exploit scientific discoveries, if he knows that at the moment of success some one else may step in and, without a cent of expense, reap the benefits of his investment of time and cash. Dr. Stewart points out forcibly why this point of view has made it impossible to get anything like full industrial value out of the inventions and discoveries made by Government employees, and why the vast advantages for research which the Government possesses have failed of their best utilization. He tells also how it is planned to remedy this unfortunate state of affairs by means of a little legislation.—THE EDITOR.

What Types of Drives Are Used in Motor Trucks?

By George W. Grupp

A STATISTICAL study in design of motor trucks is always interesting. It shows the results of progress in the automotive engineering profession. Design of motor trucks, as well as other things, is based on the results of actual experience. A close study in percentage of final drive by motor truck models offered and produced during the last few years is indicative of much experience.

The accompanying charts make clear the rise and fall of the different types of final drive. In making a study of these charts let us begin with the one showing the final drives offered. At a glance one sees that the worm drive made a steady rise from 11.5 per cent to 66.5 per cent with a slight falling off in the 1920 models offered. On the other hand the chain type of final drive has declined from 68.5 per cent to 5 per cent. There has also been a continuous falling off in bevel and double reduction types of final drive models offered. The only type which has made a continuous rising movement is the internal gear.

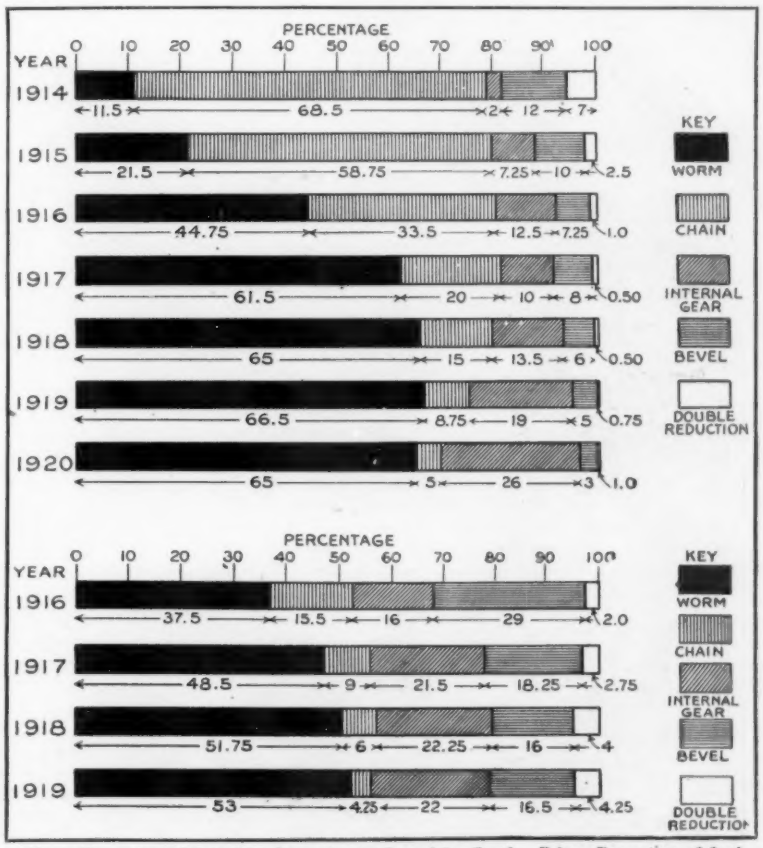
To all of this there is another side, and that is the percentage of final drive by motor truck production. In a study of this chart one finds that the worm drive has constantly increased and has not experienced a falling off. The internal gear shows a slight falling off. The chain and bevel gear final drives have declined throughout the period while the production of double reduction final drive has increased.

To make these studies more clear a very brief discussion of each type of final drive will be helpful. First, the worm drive employs a worm to drive the worm gear on the rear exle. This type of drive makes possible a very large speed reduction—a very important advantage in the design of slow speed, heavy service vehicles such as motor trucks. It is difficult to get a gear ratio of more than 5 to 1 with a bevel gear or chain drive. Compared with an internal gear it offers a single reduction. As a whole, it is simpler in construction, it is protected from dirt and weather conditions, its operation is silent and it has a wider range of gear ratio than the others.

Secondly, the chain drive is so familiar to all that it needs no introduction or description. Its chief advantage over other forms of final drive is its slightly greater flexibility. Therefore the motor and tires are given slightly greater protection against such shocks as are offered by the road, clutch, etc.

Thirdly, the bevel gear final drive has two plain bevel gears, which mesh together and change the direction of power, at right angles, from the propeller shaft to the rear axle. Its advantages are its great efficiency, noiselessness, complete enclosure, thus protecting it from dust, and its ability to reduce backlash or lost motion.

Fourthly, double reduction final drive is offered in three forms. Each, however, has one pair of bevel gears to change the direction of power from the propeller shaft to the rear axle. The bevel and the spur gears use live axles which are entirely enclosed. The gears themselves are located at the middle of the rear axle. In the case of the internal gear a dead axle is used. The driving wheels are mounted on the ends of the dead axle. On the end of the differential countershaft is a spur pinion. This meshes with an internal gear fitted on each wheel. All three forms of double reduction offer the greatest amount of reduction by a second set of wheels.



Above: Percentage of final drive by motor truck models offered. *Below:* Percentage of final drive by motor truck production.

How the various types of motor truck drives have fared since 1914

Power from Peat—An Interesting Irish Experiment in Fuels

By A. R. Surface

THE high price of fuel has again raised the question of utilizing to a greater extent the extensive deposits of peat in Ireland. The Government is at present considering the report of the committee which some time ago inquired into peat resources of the country.

In the meantime a Portadown concern has had some satisfactory results by utilizing peat in gas-producer plants for generating electric power to drive a weaving factory. The factory is driven by three Stockport gas engines, one rated at 150 and two at 120 boiler horse-power. They are single-cylinder engines driving the main shafting through ropes. The gas plant comprises gas generators, wet and dry scrubbers, tar extractors, fan and gas holders, and is supplied with peat as it comes from the bog by means of a transporter which delivers direct from the barge into the hopper of the generators.

According to a test made under ordinary factory conditions without any special preparations, the average indicated horse-power during a full working day of 10 hours, diagrams being taken every half-hour, was 277.4, and the amount of peat consumed 7,712 pounds. This is equivalent to 2.78 pounds per indicated horse-power-hour, or, assuming 88 per cent, mechanical efficiency, 3.16 pounds per boiler horse-power-hour. Allowing 3 cwt. for banking the all-round consumption may be taken as 3.5 pounds per boiler horse-power-hour, as an outside figure.

The peat used in the trial had on the average about 25 per cent of moisture. Mr. Parkinson calculates that by handling large quantities, and employing every practical labor-saving device, the peat can be won from the bog, dried, and delivered for a radius of five miles into a generating station at a price which would not exceed 0.28 pence per unit of electricity generated. He calculates that a modern steam turbine plant, operating at 160 pounds to 180 pounds pressure, 100 degrees Fahrenheit superheat, and 28-inch vacuum, would, under similar conditions of load, cost 0.42 pence per unit, with coal at 35 shillings per ton, and that an anthracite gas plant would cost 0.36 pence per unit with anthracite at 45 shillings per ton. In addition, he points out that peat gas plants would probably be worked in conjunction with recovery of by-products, the sale of which would further reduce the cost of the power generated.

Something New in Fluorescent Screens for Radioscopic Work

By M. Tevis

THE fluorescent screens hitherto employed for radioscopic examinations have employed platinum as an essentinal constituent, making use of the platinocyanide of barium. In spite of the cessation of military activities, platinum is still exceedingly scarce and costly, due to the immense extension of its various industrial uses, and the cutting off of the major part of the Russian sources of supply. It is of great interest, therefore, to learn that a substitute has been found for it in the making of fluorescent screens. Messrs. T. Roubertie and A. Nemirovsky have recently described the successful results of their researches in this line of substitution to the French Academy in Paris.

It was discovered by one of these investigators in 1911 that the tungstates become luminous under the influence of X-rays. After considerable experiment they have succeeded in preparing new fluorescent screens with these tungstates, in particular with cadmium tungstate, thus avoiding the use of platinum.

The coatings obtained are free from the permanent phosphorescence possessed by the screens employing various sulphides which have also been proposed for this purpose. These cadmium screens are nonsensitive to the action of the atmosphere and to that of physical agents. They are also very resistant to the prolonged action of X-rays which causes deterioration in the screens which make use of platino-cyanide. Under the influence of X-rays they exhibit a white luminescence, the radioscopic body showing black on the surface of the stream. The image resembles positive radiographic proofs made with bromide paper.

This property has a double advantage. In the first place it renders radioscopic examination not only more agreeable but more exact; it is a well-known fact that with a platino-cyanide screen the images exhibit a violet color on a very brilliant yellowish green plate; as a result of this the eye of the operator rapidly becomes fatigued. The second advantage claimed is that it will be possible to take moving pictures of the images formed upon these new screens, which the platino-cyanide screens do not permit. Besides these technical advantages the new screens are considerably less expensive than those which make use of platinum.

Where There Is No Sugar Shortage

WE are all familiar with the age old saying, "Water, water everywhere but not a drop to drink," and while we are not accustomed to hearing this changed to "Sugar, sugar in our house but not a grain to use," it is true in some parts of this country. What is more to the point it is legally true according to the laws of some states.

With the shortage of sugar has come a great interest in any production which is a substitute for that article and one of the most natural supplies has come from the bees. In some localities last year the season was very damp and unproductive for honey merchants. One place particularly affected was lower Connecticut.

According to the regulations each beekeeper was obliged to register his bees or pay a fine for negligence. When bees were properly registered and application sent to the Agricultural college a permit was returned to the owner which, when presented to the proper authorities in Hartford, would result in ten pounds of sugar for a hive of bees. In this way many bees will be kept alive which would have starved to death this fall on account of the difficulties of the past wet season. By allotting the ten pounds of sugar *for bees only*, at this critical time swarms will be saved to produce many, many pounds of honey during the coming season.—By *B. M. Bucll.*

A New Electric Thermocouple

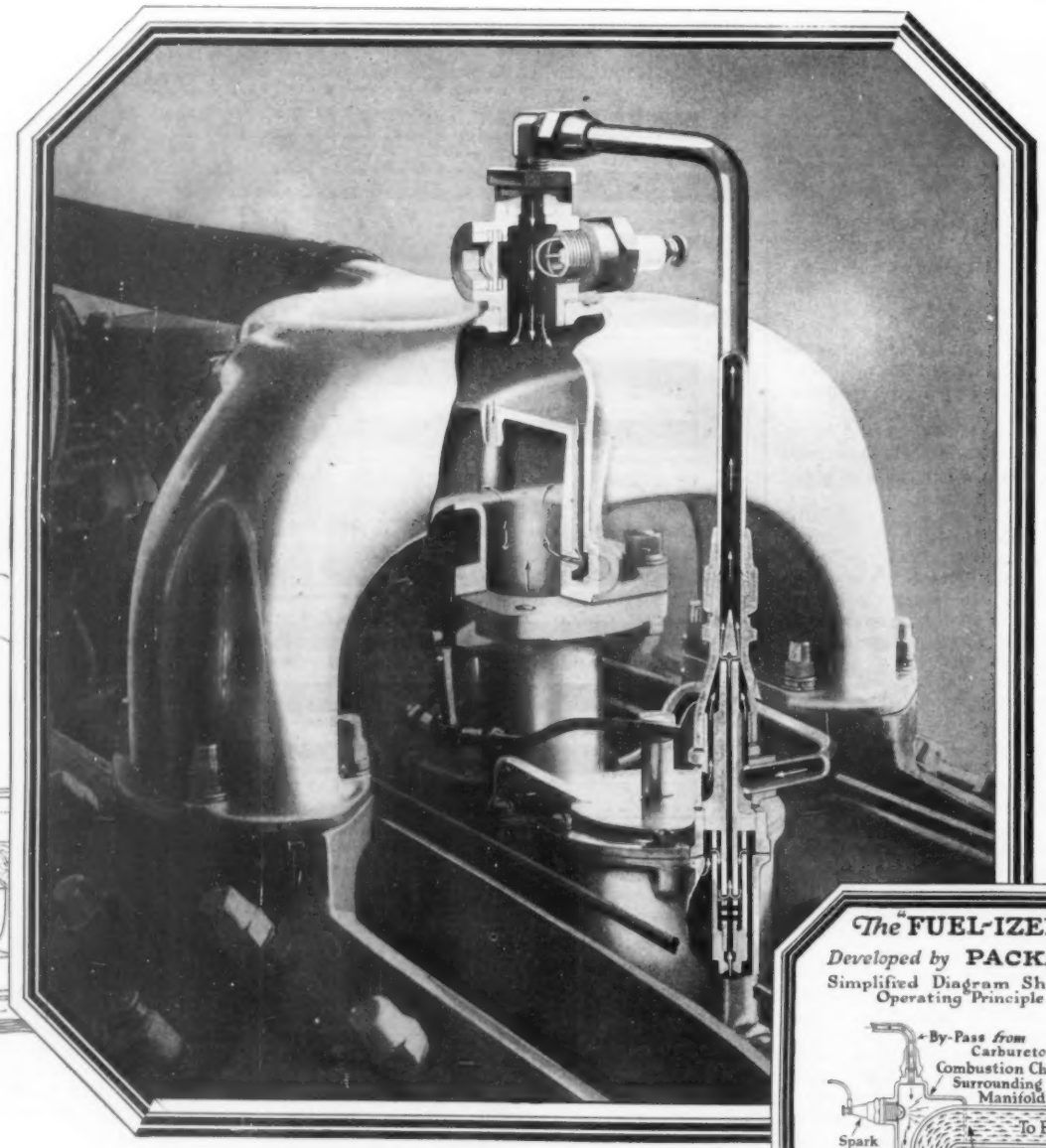
A NEW metal that bends when it is heated has just appeared. It is called thermostatic metal and is a British invention. It is prepared by permanently uniting, throughout their length, strips of the two metals having widely different co-efficients of expansion with heat, so that under a change of temperature the combined strip bends one way or the other. The reaction is stated to be always the same, in a strip of given length and thickness, for a given temperature change, and thus to provide a reliable basis for temperature indication, control, or compensation in oven thermometers, electric heaters, ice machines, and other apparatus including scientific instruments of high precision. The component metals will not corrode under ordinary conditions, and they may be used in any reasonable situation without fear of deterioration or change in their operating characteristics. They will not separate, no matter how much the strip is bent, twisted, or hammered, and even with heating the bond between them will not be broken down at a temperature below the melting point of the softer of the two. They can be formed into any desired shape and annealed after formation, and they can be safely employed at any temperature below 500 degrees Fahrenheit.

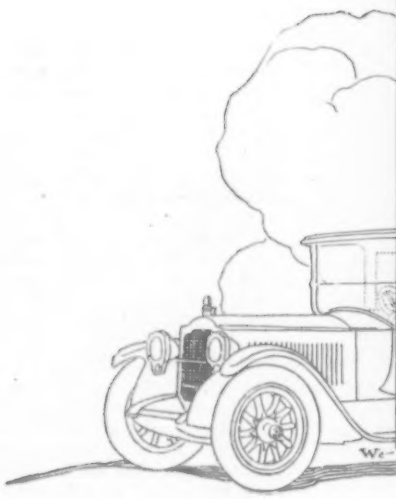
Packard scores another

The "FUEL-IZER"

Makes Any Gasoline a Perfect Fuel

Sectional view of Fuelizer built into the carburetion system, forming a bypass between the float chamber of the carburetor and the manifold. The arrows show its operation — Automatic, Safe, Silent. No moving parts — no adjustments.

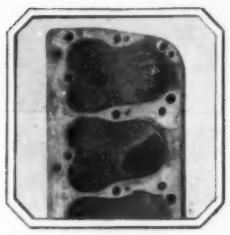




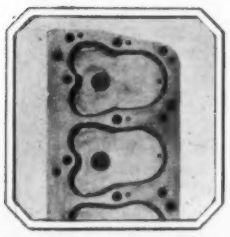
PACKARD MOTOR CAR

Engineering Triumph

This Marvelous Achievement Standard Equipment on every new Packard Car - Simple, Positive, Automatic - Gives Packard owners Freedom from Carbon troubles, Spark Plug fouling, Cold Weather Starting troubles - and Protects Oil from dangerous dilution



Part of cylinder head — motor without Fuelizer. The best designed motors known show such carbonizing in a few thousand miles.



Part of cylinder head. Motor equipped with Fuelizer. Mirror surface of cylinder head unchanged after 5000 miles.

Motor completely packed with snow. Temperature of air was 11° above zero. Seldom is a motor in actual service so thoroughly chilled.

Motor started instantaneously. The Fuelizer rapidly thawed its way through snow. Perfect response to throttle attained in 10 seconds.

WITH the development and perfecting of the "Fuelizer"—Packard Engineering again demonstrates its faculty for going to the heart of a problem and getting *practical results.*

The Fuelizer achieves *perfect combustion* of all grades of gasoline.

It makes starting as quick and sure in winter as in summer.

It makes available the power in any grade fuel more quickly.

It does away with carbon fouling of combustion chamber, crankcase, valves and spark plugs.

It does away with the dilution of lubricating oil in the crankcase—removing the main cause of premature wear on engine bearings and scoring of cylinder walls, and preventing sticky valve guides and valve stems.

* * *

Small wonder that the Fuelizer proved the sensation of the recent annual meeting of the Society of Automotive Engineers!

Every motor engineer had known for years that the proper application of *heat* will break up "wet" mixture.

How to apply the heat has always been the problem—now solved by the Fuelizer.

The Packard Fuelizer not only applies the *right degree* of heat at the *right place*—

But more important still—it applies the heat at the *right time* —when the *engine* is *cold* at starting; and maintains an ideal heat—*not overheat*—under all running conditions.

* * *

These illustrations tell, better than many words, how the Fuelizer does its wonderful work.

A small part of the mixture is drawn into the Fuelizer and exploded into *hot gas* by the spark plug.

This hot gas is drawn down through the Fuelizer heating manifold into the "wet" mixture in the main manifold. It heats up and breaks the "wet" mixture into a dry vapor, which explodes *completely* in the cylinders.

No time lost in "warming up!"

The Fuelizer has raised the manifold temperature from 33° to an ideal temperature (120° or over) in less than forty-three seconds—2°a second!

Tests made last winter at 5° below Zero showed that the engine is able to pull on *high gear* almost immediately.

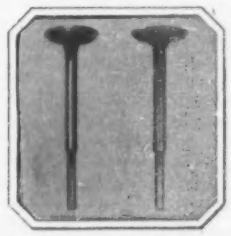
During the months of testing after the perfecting of the Fuelizer, not one single case developed of foul spark-plug or valve, combustion chamber wall or piston rings. Nor was there any dilution of oil.

Winter or *summer*, the Fuelizer revolutionizes motoring—reducing repair bills—lengthening the useful life of a motor.

A Packard achievement. *Exclusively* Packard — now *standard equipment* with every new Packard Car.

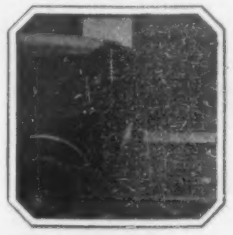
In every way a development worthy of the long established Packard tradition of *practical transportation service* to the owner of a Packard Car.

Oil tests without Fuelizer showed lubricating oil diluted with over 7 ounces deposit of kerosene in 4 hours of idling. With Fuelizer, no dilution.



Left—Valve from Fuelizer-equipped motor after 6200 miles.
Right—Typical carbonized valve from motor without Fuelizer. Note burning of metal.

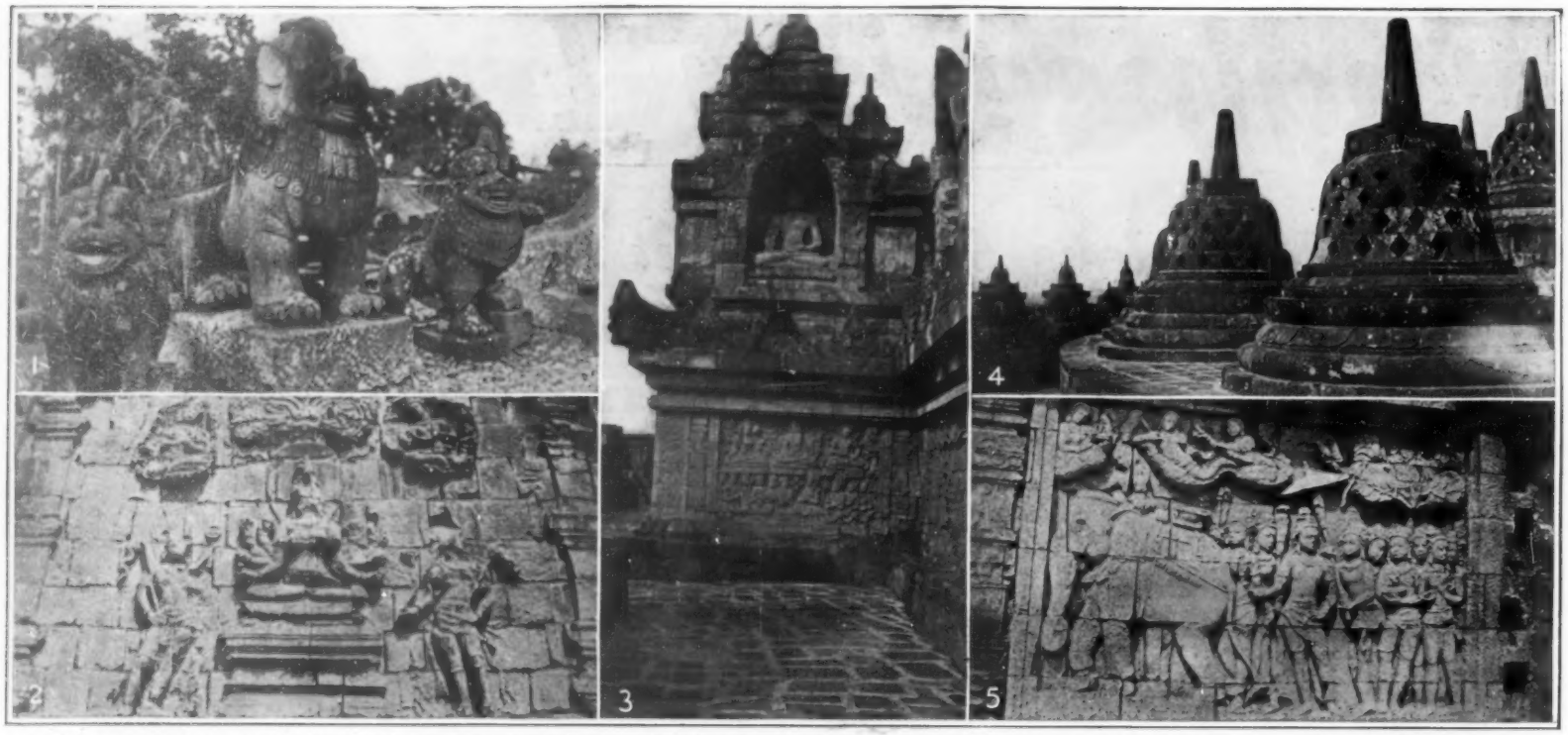
Any car without Fuelizer if started after idling exhausts mist of unburned gasoline and wasted oil.



Packard Car with Fuelizer starts instantaneously. Invisible exhaust after idling or when starting indicates perfect combustion.

"Ask the Man *Who Owns One"*

COMPANY, Detroit, Mich., U.S.A.



1. These stone lions have been laughing for the past thirteen hundred years, with little if any signs of wear. 2. One of the many ornamental panels representing incidents in the life of Buddha 3. A statue of Buddha sitting upon a lotus leaf. 4. Some of the seventy-two lattice-worked stone *dagabas* or shrines. 5. Another panel representing the life of Buddha.

Some details of the remarkable hill temple of Boro-Budur in Java

Making Boro-Budur Known

An Airplane Project Which Is Designed to Popularize a Wonderful Javanese Temple

By Francis Dickie

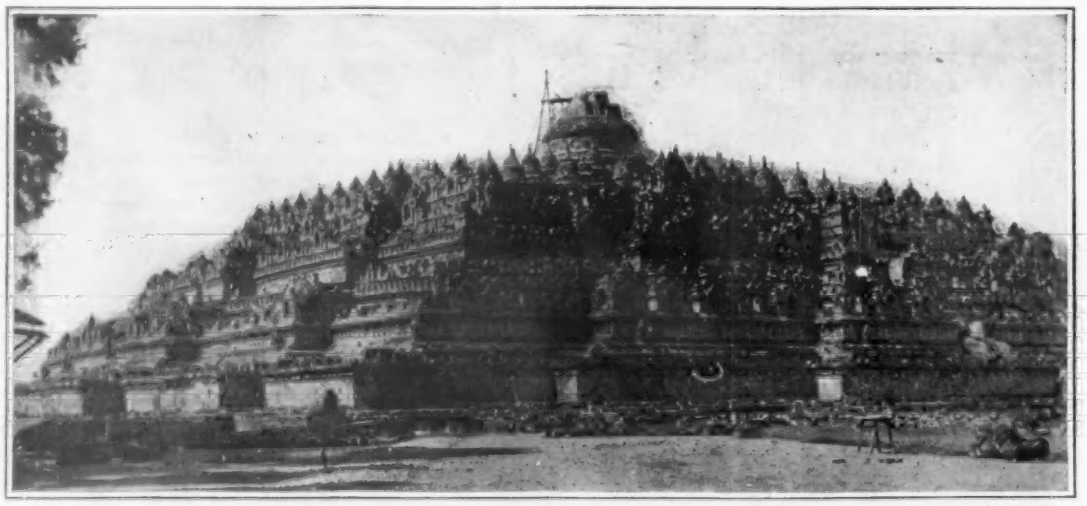
IT is a peculiar fact that some of the great wonders of the world are known to the general run of men and women almost from infancy, while others, quite as remarkable, indeed more so, remain unknown to the world at large. The most striking example of this is the magnificent hill temple of Boro-Budur, one of the most gigantic and finest works ever reared by the ancients. Boro-Budur represents more human labor and artistic skill than the Great Pyramid. Yet everyone has heard of the Great Pyramid, while practically no one knows of Boro-Budur.

Boro-Budur was built about the seventh century A. D., as far as is known from philological research. It lies in central Java and owes its origin to Buddhism. The ashes of Buddha were distributed by his great apostle, King Osaka of India, to eight towns where they were buried. Some time after the ashes were taken from the tombs and redivided into 84,000 parts. These were preserved in vases and given out over all his dominions. When the Buddhist missionaries came to Java in the seventh century they brought one of these vases and, as a fitting receptacle for this, Boro-Budur, the world's greatest temple, was erected—the finest piece of architecture of its kind in the then known world, and one which has never been rivalled since. For about eight hundred years Boro-Budur was visited by millions of worshippers; then a Mahomedan invasion swept the country and the temple was deserted. Jungle grew about it and volcanic debris, from the countless active craters the island is famed for, covered it. In 1814 it was discovered by accident by Sir Stamford Raffles, who started the work of restoring the temple to something of its former glory, which was continued by the Dutch authorities when they took back the island at the close of the Napoleonic wars. Due to this restorative work, the temple can be seen today much as it was thirteen hundred years ago.

Its out-of-the-way position and the rather indifferent service by train, pony cart, and later auto-bus, are the principal reasons why it is not being visited by more travelers. In addition to this, it has not been extensively advertised like the Pyramids. All this now bids fair to be changed, for even in the Malay Archipelago—the land of rest, "tomorrow" and backwardness—things are now going ahead with leaps and bounds. The most startling of all is the project of an airplane service to handle mail and passengers between different points in the Archipelago. The undertaking is backed by Dutch capitalists, the most conservative men in the world, so it may be taken for granted that it is thoroughly feasible or they would not have considered it.

And with airplane service Boro-Budur may come into its own. This world wonder, so long unheard of and neglected by the world at large, will be visited by thousands of globe trotters availing themselves of the airplane service. To tell fully of all the temple's marvels and beauties would take a book. Of it Alfred Russell Wallace, the great scientist, said: "The human labor and skill expended on Boro-Budur is so great that that expended on the Great Pyramid sinks into insignificance beside it." The following brief description and, perhaps better than that, the six photographs here shown and recently taken by Frank Burnett, Canadian amateur archaeologist, will convey to the reader something of the magnificence and the grandeur of this huge hill temple:

One of our views shows Boro-Budur as it is today, an artificial many-sided mound, a series of galleries, cupolas and spires, surmounted by a vast central dome, 52 feet in diameter, which at one time, it is supposed, was crowned with a spire. Upon ascending the outer terrace of this hill temple, a thirty-sided plain is reached. This, however, is not the original foundation. Excavation has disclosed two other terraces six and ten feet respectively below the level of this plain. The Buddhist builders apparently deemed it advisable in this way to strengthen their structure while in course of erection. Formerly a heavy stone parapet surrounded the existing plain. In the middle of each of the four sides of this parapet an opening gave access to a flight of stairs, at the sides of which were heavy banisters. At the lower end of the stairs are huge laughing lions of stone, which still remain with their fixed laughter after thirteen hundred years,



General view of the Boro-Budur temple which, as a piece of architecture, is perhaps the greatest work of the ancients of the Far East

(*Continued on page 412*)

Homes for the Martin Bird

IF farmers would realize how much good the martins do for their farms, they would surely prevent the destruction of these birds and build suitable homes for them. The martins feed exclusively on insects, catching their food while flying and before the insects have a chance to settle on the farmer's crops and do damage. A Cincinnati farmer who realizes these facts has built the beautiful bird house shown in the accompanying illustration, wishing to attract the useful martins and enlist their aid in his work. The house is built of cement.—By *Roy Newton.*

Cheap Extraction of Salt from Sea-Water

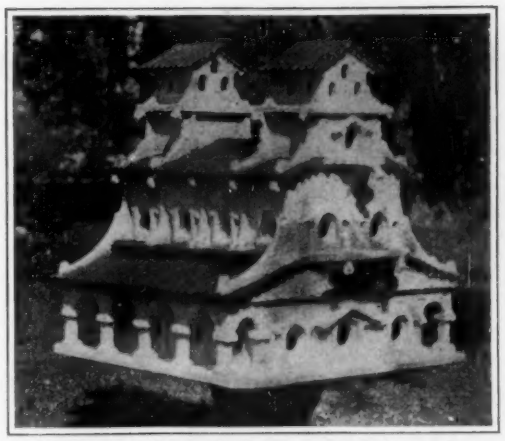
A NEW process invented by Professor Helland Hensem promises to develop into an important Norwegian industry. It is intended to extract the salt in sea water by evaporation in a specially designed plant which embodies the principle of regeneration, but is without the difficulties hitherto encountered when attempted on a large scale. The quantity of energy required when the principle is fully utilized is very small indeed, and it will find a wide application in many chemical industries.

Brine is circulated through a nest of vertical tubes, the outside of which is heated by steam, thus producing active evaporation. The resultant brine vapor is exhausted by a pump, compressed adiabatically, and forced into the steam space around the tubes. The heat of evaporation is thus retained and used again and again. It is claimed that the make-up heat required to maintain the process is very small, and that one pound of coal is sufficient to evaporate 800 pounds of sea water.

It is further claimed that by concentrating brine from 3 per cent to 25 per cent with a final difference of only 40 degrees Centigrade, a kilowatt year will transfer 15.6 tons of salt to the higher concentration and that it is possible to obtain 62.4 tons of concentrated brine per kilowatt year. The evaporation of sea water for the purpose of extracting salt is, therefore, remunerative where cheap electric power is available.—By *Teknisk Ukeblad.*

A New Source of Vegetable Oil

THE *Bulletin* of the Imperial Institute calls attention to a new oil bearing plant of the lettuce family, the *Lactuca scariola, var. oleifera.* This is already cultivated in upper Egypt and can be grown with profit in certain parts of the Sudan, together with sesame. The seed yields under pressure from 37 to 38 per cent of an edible oil. Certain specimens of fresh seed from the Sudan, containing 3.9 per cent of water, when examined at the Imperial Institute yielded 44.2 per cent of oil, which is equivalent to 46 per cent from the dry seed. The oil is odorless and of a beautiful light yellow color; it is without disagreeable taste. It is classed among semi-siccative oils. Because of its very small size the lettuce seed cannot be handled with the ordinary equipment. This circumstance, however, will doubtless present no obstacle to its commercial exploitation, since the oil is valued at 1,500 francs per ton and is very suitable for the manufacture of soap and other similar products.



A Cincinnati farmer built this concrete house for martin birds

Mexican sugar cane at the time of harvesting

What Is Cane Sugar?

IT is said that blessings brighten as they take their flight. If this be true, there should be an increased interest in cane sugar and the plant from which it is derived.

So far as we know, sugar-cane was first cultivated in India, and was introduced from that country into the valley of the Euphrates, Arabia, Egypt, and Spain. Columbus on his second voyage in 1493 brought it into the New World, where it was destined to become one of the most important crops.

The first sugar exported to Europe was grown on the plantations established by Cortez in Mexico. The soil and climate of Cuba are peculiarly adapted to the cultivation of sugar-cane and it has been grown on that island in great quantities. The first plantations in Louisiana were a failure, but the purple variety of cane has been found to grow well there and also in other parts of the southern United States.

Sugar-cane requires an abundance of sunshine and water and a deep, fertile soil. In planting, the stalks are laid lengthwise in furrows, and each joint sends up a shoot, which later produces suckers. When ready for harvesting, a field of sugar-cane resembles a cornfield, but the plants are somewhat larger and there are no tassels and no ears. The stalks at this time have been growing about twelve months and have changed from green to reddish in color, while most of the lower leaves have fallen away. They are cut by hand with a long knife, stripped of their leaves, and carried on carts or small cars to the sugar mill.

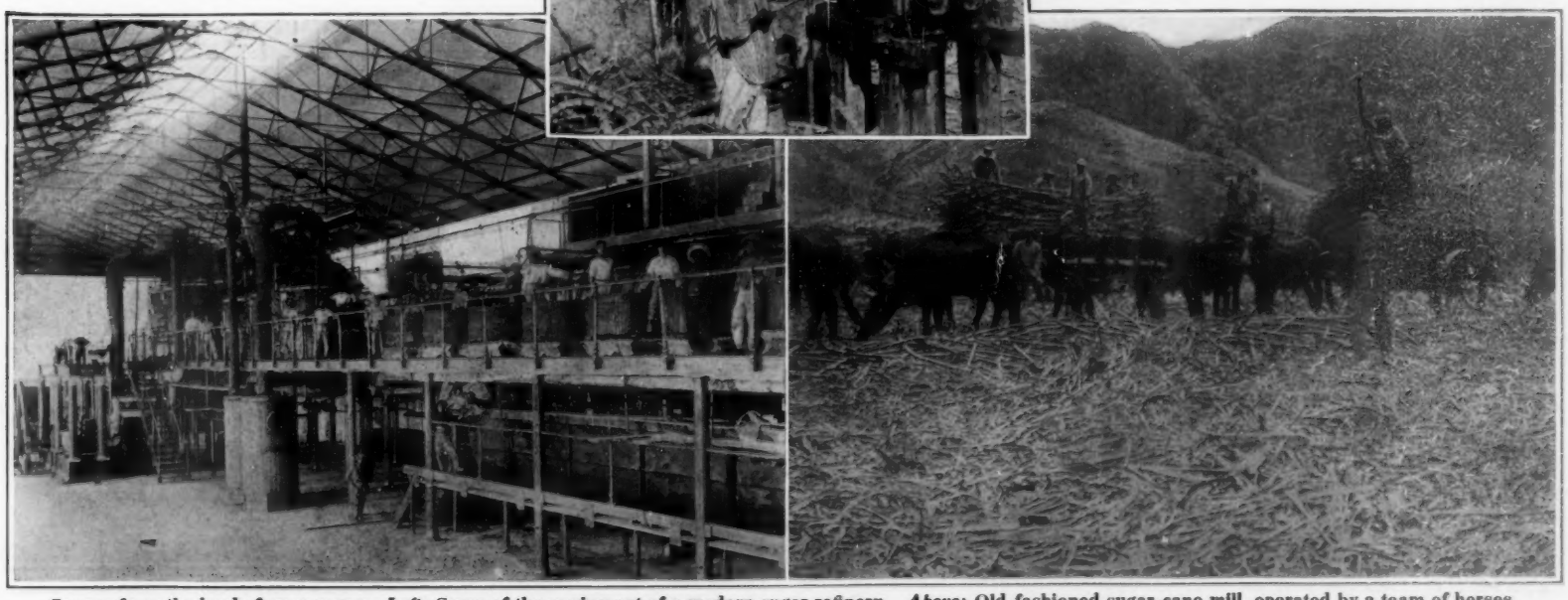
A fire in a field of ripening cane is a terrible thing and much dreaded by planters. There are also hurricanes, blights, borers, white ants, rats, and other pests to be reckoned with wherever cane is grown.

Sugar-cane stalks are surprisingly heavy and contain 18 per cent of sugar. The sweet juice is extracted by crushing them between rollers and it is then boiled down to a point where the sugar separates out as brown crystals, leaving behind a syrup known as molasses. Pure white sugar is made at the refineries, where the impurities are removed by washing, filtering, decolorizing and repeated crystallization.

Many other plants contain sugar and have been used for its manufacture. The bamboo was used for this purpose in India even before sugar-cane. In China, sorghum has long been a favorite source of syrup. In the United States, the Indians tapped the wild maple trees and made maple sugar very much as it is done today. In Mexico, the century-plant was formerly a source of sugar, but it is now almost entirely given over to the manufacture of *pulque*, an intoxicating beverage.

Plants store for their own use starch and sugar, and man uses these stores for his food. Nature alone seems able to supply the sweet crystals which the chemist has so patiently sought to make in his laboratory. For these mankind must depend largely upon sugar-cane and the sugar beet.

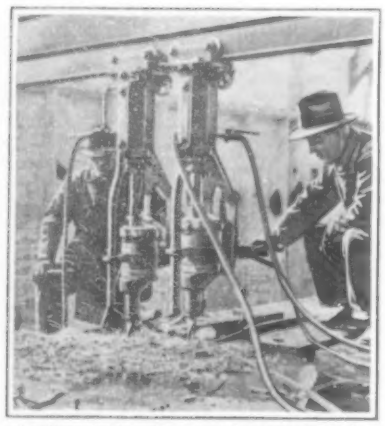
It seems almost incredible to an American, who consumes much more than his share of the world's output of sugar, that this delicious food was first used only as a medicine. Even as late as the thirteenth century, it cost two or three dollars a pound—which is not quite so incredible in view of present prices!—By *W. A. Murrill, Ph.D.*



Scenes from the land of cane sugar: *Left:* Some of the equipment of a modern sugar refinery. *Above:* Old-fashioned sugar-cane mill, operated by a team of horses *Right:* Ox carts used in hauling sugar cane

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Drilling boiler plates with electric drills mounted on rails

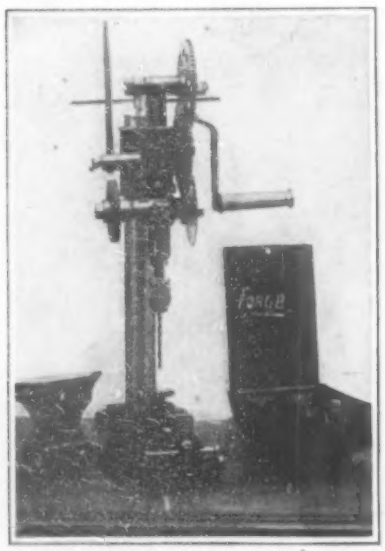
Electric Drills on Overhead Tracks

A PARTICULARLY interesting method of using portable electric drills in the operation of drilling boiler plate has been devised by a machinery manufacturer on the West Coast. The drills are allowed to be moved to the desired positions by means of a track consisting of an extra truss supported on top of a span. From this I-beam one to four drills may be suspended. In a sense the track is nothing more nor less than a monorail for the side travel of the drills. End girders traveling on standard gage rails support each beam. Such an arrangement allows the drilling of holes in any part of a plate by as many as four drills at a time.

Three thicknesses of metal are drilled at one time. Boiler plate with a thickness of 1 9/16 inches is drilled with this device. The 4 11/16 inches of metal of the three sheets is drilled through in an average time of 8 minutes per hole. In diameter the holes measure 1 9/16 inches.—By *Allen P. Child.*

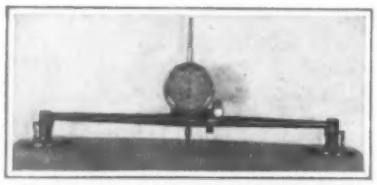
The Compact Machine Shop

MACHINE work, even when of the simplest sort, usually brings visions of a large array of expensive machines and tools. But a Belgian inventor has dispelled these visions by introducing a simple combination machine which forms the subject of the accompanying illustration.



All kinds of light machine work can be done with this equipment

This new machine is practically a complete automobile repair shop. It includes an adjustable drill which serves a variety of purposes, such as drilling, sawing, grinding valve stems and other parts, and so on. The drill is hand-driven through one or more gears, so that the speed of the chuck is greatly augmented. Eight hundred revolutions per minute can readily be obtained, and a change of gears lowers the speed for different kinds of work. The vise which serves to hold work for the drill can also be used for other purposes. The stand for the drill permits the drill to be used at any angle and in any direction; furthermore, the stand is in reality a very efficient air pump for inflating tires and for operating the diminutive forge which does odd jobs. A small but sturdy anvil completes this novel equipment.—By *George Gaulois.*



This device indicates the wear on our public roads

Measuring the Wear on Roads

THE wear and tear on public highways from automobiles, heavy motor trucks and vehicles of less impression need not longer be guesswork if an invention of A. T. Goldbeck of the U. S. Bureau of Public Roads, proves in practice the claims for it in theory. The instrument should not only satisfy the curious as to the wear caused by traffic but afford valuable data as to the relative durability of concrete, brick macadam and other road surfaces.

The instrument has a capacity for giving readings to the fineness of one-thousandth of an inch. The device consists of two bearing plates each 2 inches in diameter, pivoted on universal joints to a spanner 11½ inches long. At the midpoint is located a micrometer, whose plunger has a travel of one inch. Readings are possible by resting the bearing plate on the road surface and permitting the spindle or plunger to rest on the base plane of the plug. The instrument is plumbed with the aid of the level bubble, the spanner bar being held parallel to the center line of the road. Another set may be taken with the bar at right angles to the center line of the road.

Brass plugs, when set in the pavement where the readings are desired, furnish measurement references continuously from year to year. These are easily placed in any pavement during the construction period, or at subsequent times by drilling small holes and setting the plugs in cement grout. Detailed blue prints of the newly-invented instrument can be had by anyone by applying to the U. S. Bureau of Public Roads, Washington, D. C.—By *S. R. Winters.*

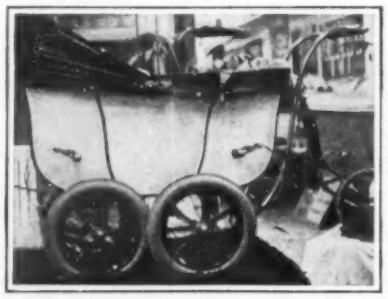
Kitchen Utensils of Stainless Steel

BY a modification of the stainless rustless steel hitherto used solely for knife blades, a process has been discovered whereby rustless steel is now applied to the production of a variety of articles, including domestic cooking utensils such as frying pans, saucepans, and kettles. This announcement appeared recently in the British press, describing an important development in stainless steel manufacture.

Rustless steel differs from ordinary carbon steel, which was formerly used for making knife blades, in that it contains a large percentage of chromium. Chromium renders steel impervious to oxidation, which, with the presence of moisture, is the cause of rusting. It also, when highly polished, resists the corrosive action of acids, such as vinegar and orange juice, and is not stained by vegetables. Up to a short time ago rustless steel was only used in the manufacture of table, dessert and pocket knives, because it was found difficult to harden and temper. That is the reason why these knives lacked a cutting edge; in fact, carving knives were not manufactured. Incidentally, it may be mentioned that this difficulty is being overcome.

What Next in Baby Carriages?

THESE columns have chronicled many interesting developments in the art of baby transportation—carriages with special shock absorbers, pull-carts with special skids that cause them to slide off a curbstone or down a flight of steps with the grace of an eel, carriages with electric lights and foot warmers, and so on. But here is a new one—from England. It is called the super-perambulator, and was one of the main attractions at the recent British



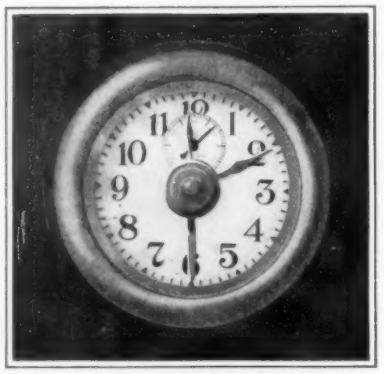
Fitted with pneumatic tires, this vehicle is the last word in baby carriages

Industries Exhibition at Birmingham. The wheels, it will be noted, are provided with pneumatic tires, and the carriage is of the most substantial construction. Obviously, it must ride like a Pullman; but who wants the job of pushing such a heavy vehicle?—By *A. R. Surface.*

A Time Switch for the Automobile Lights

IN many instances a car is left standing on the street in the afternoon and the owner finds it inconvenient and sometimes impossible to get back to it in order to turn on the lights at the time required by law. At any rate, there is no reason why an automobile's lights should not be turned on and off automatically, following the modern practice of the show-window lights and time switch. And the simple little device shown in the accompanying illustration does the trick.

The automobile light control is the invention of Werner O. Olson and J. Ovsiovitch, both of Newark, N. J. These inventors have spent many years with



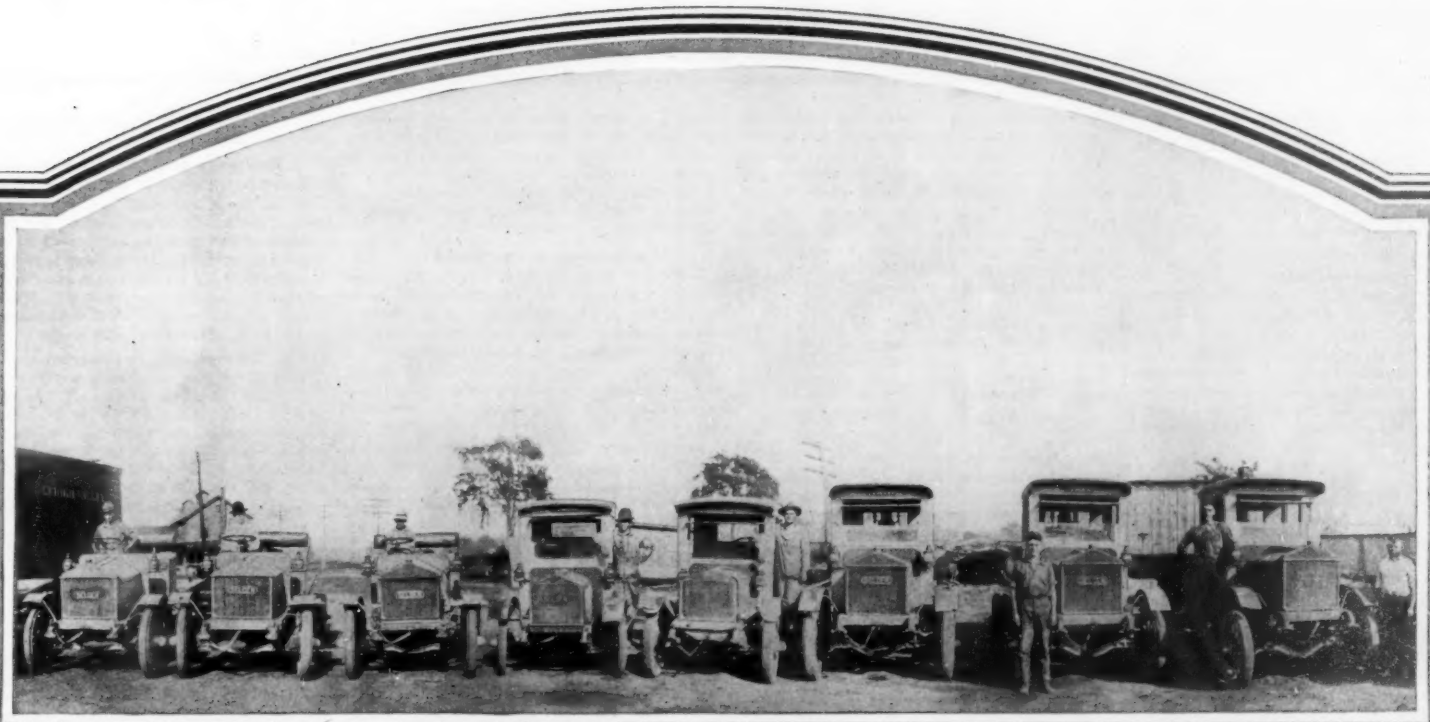
This contact device controls the automobile lights for any set time

Thomas A. Edison in his laboratory at West Orange, N. J. The main obstacle which had to be overcome in developing the automobile light time switch was the magnetizing of the clock. This has been accomplished by making the contact device entirely separate from the clock mechanism; in fact, the contact-making members are carried on the crystal of the clock and are actuated by the clock's hands, so that no current whatsoever passes through the works. The device may be attached to any clock in short order. The contact device can be set for any time by means of the little knob, and connections can be made with any circuit which is to be controlled, such as the dimmer switch, parking lamp switch, and so on.—By *Clarence Wilson.*

Daylight "Movies" for Street Crowds

TAKING full advantage of the advertising possibilities of motion pictures and lantern slides, an enterprising Berlin inventor has introduced the novel screen arrangement shown in the accompanying illustration. This device, which was first shown at the recent country fair held in Leipzig, consists of an open chamber with a silvered screen at the farther end. The interior walls are blackened so as to absorb all light falling on them. The screen, in this manner, is sufficiently darkened so as to permit motion pictures in bright daylight.—By *A. Krauss.*

This booth permits motion pictures to be shown in broad daylight



Selden Trucks Make a Record on Toledo-Buffalo Road

With the aid of ten SELDEN Trucks, twelve miles of monolithic brick paving were laid on the Toledo-Buffalo road, between Ashtabula and Conneaut, Ohio, in the record time of ninety-two days. And this road is pronounced by State and National Highway officials to be one of the finest in America.

Nearly two thousand carloads of materials, including six million paving bricks, were used in the construction of this half a million dollar road—the majority of which was hauled by ten SELDEN Trucks. The average haul was 2½ miles and an average of 100,000 bricks were hauled daily.

"Working alongside of four other leading makes of trucks my SELDEN Trucks gave far better satisfaction," says Thomas P. Fitzgerald, the contractor.

Similar stories of highly efficient performances of SELDEN Trucks continue to come to us from the largest operators of motor trucks in this country.

"Truck Transportation" will be mailed free to all interested upon receipt of request to Dept. S. SELDEN TRUCK CORPORATION Rochester, N. Y.

Ship by Truck—SELDEN Truck

1½, 2½, 3½, 5 Ton Models—All Worm Drive

Selden Motor Trucks

SELDEN TRUCK CORPORATION, Rochester, N. Y., U. S. A.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

PLOW.—J. R. TINNEY, Box 1158, Phoenix, Ariz. The invention relates to farm implements, and has for its object to provide a plow which will be self-cleaning and non-chokable wherein the connection between the plow and the beam is so placed that the soil, rubbish and the like will pass over the plow share without being held.

Electrical Devices

AUTOMATICALLY CONTROLLED ELECTRIC SYSTEM.—F. W. and C. M. KIMBALL, 223 Wilson Ave., Detroit, Mich. An object of the invention is to provide a system which may be used in isolated places, such as country homes in which a generator is driven by an internal combustion engine for producing the current, and in which the mere turning on or turning off of the lights or other electric device, will start the system in operation, the turning off effecting the stopping of the engine and generator, and the restoration of the system to a normal condition of rest.

SELF-COOLED IMPACT SPARK GAP.—H. E. HALLBORG, 305 Lucille Ave., Norfolk, Va. An object of the invention is to provide a quenched spark gap which is light in weight, especially reliable in its working due to the absence of fan or blower protective devices, auxiliary leads, switches, etc., and to the further fact that it is self-contained and has nothing inflammable in its construction. The invention is simple and may be easily operated.

ELECTRIC SIGN.—A. BLUM, 11 Lookout St., Bogota, N. J. This invention relates to signs in which incandescent electric lamps are illuminated in groups to indicate letter, numerals and other characters forming the legend of the sign. The object is to provide an electric sign in which each character forms a unit adapted to be conveniently inserted in a sign frame or removed therefrom without disturbing the other character units.

Of General Interest

COMBINED HEAD-COVERING AND HAIR-COMB.—A. K. DAWSON, 397 West St., c/o M. Muney, New York, N. Y. The invention has particular reference to a means for carrying in peculiarly neat and inconspicuous manner within or as part of the head covering a comb, adapted to be used for combing up the hair of the wearer of the head covering. The device is so constructed that the wearer may comb up his hair coincidentally with the removal of the head covering from the head.

SHOE HEEL BREAST BUFFER AND PAPER FORMER.—H. G. BENDIX and H. FORTH, 195 Lefferts Ave., Brooklyn, N. Y. This invention relates to shoe heel breast buffers especially adapted for use in connection with Louis X. type of heel. Among the objects is to provide a buffer adapted for high speed operation and having an abrasive surface formed of a minimum amount carborundum paper or its equivalent. A further object is to provide means for shaping and applying the abrading element to the buffer body.

REVOLVER CLIP.—M. M. GLASSER, 446 King St., Charleston, S. C. The object of the invention is to provide a device for rigidly connecting the filling for the cylinder of a revolver in such manner that the entire filling may be inserted and removed at a single operation, and wherein the device will not interfere with the closing or rotation of the revolver after the chamber is filled.

DUMB WAITER.—F. BARTLETT, Enderlin, N. D. The object of the invention is to provide a dumb waiter of simple construction in which the minimum number of guide pulleys is employed which are so arranged and related that a direct pull may be exerted upon the operating cable threaded thereabout, and in which the movable carriage is provided with means whereby it may be quickly and easily disengaged to permit its removal for cleaning, repairing or other purposes.

FIREARM CONTROL.—F. D. ELY, Fort Leavenworth, Kan. The invention has reference to the indicator of fire-arm controls. An object is to provide a direct-reading scale with means for throwing the control into and out of operation, and to provide a control which locks automatically at a predetermined point of the scale.

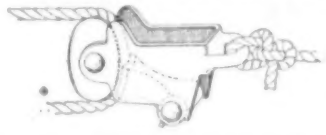
PROCESS OF CLEANING SUGAR-MAKING APPARATUS.—E. H. MAN, 1119 Rampart St., New Orleans, La. An object of the invention is to provide a process by means of which the various sugar making devices may be cleaned with a minimum amount of labor and expense. The process consists in filling the vessels with a water solution of sulfur-dioxide gas, permitting the solution to stand in the vessels for a few hours, until the scale has softened and subsequently removing the scale thus softened.

ERASER HOLDER.—W. BLOOM, 202 W. 107th St., New York, N. Y. The invention has for its object to provide a construction whereby the side plates may be quickly removed for allowing the erasing material to be completely used and a new one substituted. A further object is to provide a holder provided with a slotted plate on one side, and on the other side a plate having a pressed out eyelet co-acting with the slotted plate for holding the erasing material in place.

SAFETY PERCUSSION FUSE, INSTANTANEOUS OR RETARDED.—E. RIMAILHO, Paris, France. This invention has for its purpose to provide a light striking-pin combined with a security disk and with centrifugal latches, the combination of said organs producing security or saftey against accidental shock liable to occur during the transport or handling, and all the actions to which the projectile is submitted.

CARD TABLE COVER.—A. KUNATH, c/o Kemp & Bealty, Inc., 906 B'way, New York, N. Y. Among the objects of the invention is to provide a temporary table cover of any suitable character of sheet material such as cloth or the like of a size and form to exactly fit the table top in flat form, and with means for firmly securing the corners of the cover to the corners of the table top, whereby the cover may be used to prevent the marring of a polished table top.

CLOTHESLINE PULLEY.—R. C. MEISTERKNECHT, Allentown, Pa. The invention has particular reference to means for locking clotheslines or the like. An object is to provide a self-holding pulley for an endless clothesline, the same being so designed as to afford free traversing of



A PERSPECTIVE VIEW SHOWING PULLEY, SHACKLE AND ENDLESS ROPE HELD IN LOCKED POSITION

the rope over the pully when the clothes are to be applied to or removed from the line, but which when it is held stationary will lock the pulley from movement by a member brought into gripping action automatically with the turning of the pulley around the axis of the line about 180 degrees.

HAIR CURLER.—IDA W. STRAHAN, 137 Gordenhurst, Montclair, N. J. The invention relates to hair curlers, which will curl the hair without the use of heat. An object of this invention is the provision of a hair curler by means of which the finished hair will have what is known as a "Marcel wave" over its entire surface. Another object is the provision of means by virtue of which the depth of the wave may be regulated. The device when in use will not be unsightly or uncomfortable.

SANITARY SOAP HOLDER.—F. MARRUCCI, 201 Market St., Newark, N. J. The invention relates to barbers' supplies and has particular reference to soap holders or shaving mugs. Among the objects of the invention is to provide an attachment for shaving mugs adapted to hold a cake or mass of soap in elevated position, but so designed as to make it convenient for the operator to depress the soap beneath the surface of a small body of water retained normally below the soap.

FASTENING DEVICE FOR CARDS, CALENDARS, ETC.—J. P. BURKE, Box 1125, Struthers, Ohio. This invention has particular reference to pins, thumb tacks, or analogous devices employed for the purpose of fastening cards, pictures, signs, calendars or other light thin bodies to supports such as walls or the like for display. Among the objects is to provide a device so constructed as to occupy a minimum space, but having specially designed fastening point, easily inserted into the wall.

DISH-WASHING DEVICE.—J. T. CARTER, 622 Jefferson St., Jefferson City, Mo. This invention relates more particularly to devices whereby dishes may be washed in a drain without the necessity of exposing the hands to the washing fluid. Another object is to produce a device wherein the soap or detergent used will be effectually mixed with water and the resulting mixture delivered onto the dishes. A further object is the provision of a device that can be quickly attached to and removed from the ordinary house spigot in the operation of washing.

Hardware and Tools

WRENCH.—H. W. WATSON, 32 N. Cooper St., Memphis, Tenn. This invention relates more particularly to that type of wrench wherein different sized sockets or spanners are used for various sized nuts. An object is to provide a wrench structure by which nuts may be quickly run up or down on a bolt and then tightly locked in place, without the necessity of the workman having to put his hand or hands on the nut.

LOCK.—Z. PEHEL, 60 E. 97th St., New York, N. Y. An object of the invention is to provide a form of mortise lock adaptable for use in doors, which comprises a minimum number of parts, and is unlikely to get out of order. Another object is to provide a lock consisting of a bolt actuated through simplified form of gear and rack, which in turn is actuated by a key, the key being so constructed as to insure against the opening of the lock with any but the key designed for that purpose.

COMBINATION TOOL AND LOCK.—W. A. SKINNER, 366 Pearl St., Manchester, N. H., care Earl T. Renter. This invention relates to combination tools and locks, an object being to provide a pair of pliers with means for locking the handles together, so that the device may serve the purpose of a tool and may also be used for locking the spokes of a bicycle wheel against possible movement.

SELF BLOWING TORCH.—E. FOLGMAN, 31 Third St., Brooklyn, N. Y. An object of this invention is to provide a self blowing torch particularly adapted for use by electrical wiremen in splicing. A further object is to provide a self blowing torch constructed to furnish a relatively constant supply of gas, formed from a hydrocarbon fuel, under pressure, so that as the fuel is burned the gas supplied to the heating flame will not tend to be elongated, due to an increased pressure of gas.

PISTON RING REMOVER.—C. D. STEVENS, 447 Atlantic Ave., Freeport, L. I., N. Y. Among the objects of the invention is to provide a plier construction which will engage a ring, spread the same and hold the ring in spread condition while it is being removed. The plier construction being provided with a jaw structure for engaging the rings in such manner that the ends of the ring will be held in a separated condition while being manipulated.

Heating and Lighting

OIL COOK STOVE LID AND FENDER.—T. J. MCKAY, P. O. Box 1522, Atlanta, Ga. This invention has for its object to provide a structure which will prevent soup or other matter from falling on the chimney and extinguishing the flame. A further object is to provide an attachment including a lid formed with supporting rings arranged to prevent an inward flow of liquid which might be boiled over or caused to flow from a container onto the lid.

HYDROCARBON BURNER.—G. P. KITTEL, 400 Main St., Union Hill, Weehawken, N. J. The object of the invention is to provide a hydrocarbon burner arranged to insure a thorough vaporization of the liquid fuel during its passage through the burner and to cause the generated vapor to issue through a jet orifice at a high velocity to form a mixture with the air and produce a large, hot, blue flame. Another object is to insure a thorough vaporization of the liquid fuel even should it enter the vaporizing coil at a low temperature or in small quantity.

Machines and Mechanical Devices

STAPLE FEEDING MECHANISM.—E. A. RUDASILL, 214 S. Washington St., Shelby, N. C. The invention relates generally to staple setting machines, and more particularly to machines for setting staples in blind slats, the object being to provide means in connection therewith, and automatically operated by the actuating parts of the machine, for supplying staples to the usual staple feeding arms thereof.

WINDMILL.—E. H. MANNING, Elkhart, Ind. An object of the invention is to provide a windmill including a rotor carrying a plurality of vanes with means for rotating or feathering the vanes on their respective axis in such a manner as to expose them to the wind at an angle of greatest efficiency at every degree of the circle while traveling with, cross and against the wind, cooperating means being provided for controlling the vanes entirely automatically.

Railways and Their Accessories

REFRIGERATOR CAR CONSTRUCTION.—G. B. TODD, Barnwell, S. C. Among the objects of the invention are the provision of a novel manner of insulating the walls, top and bottom of the refrigerating chamber so the cold will be maintained within the car and at the same time not be affected by outside temperature whether it be high or low, a freezing outside temperature having no bad effect upon the articles stored.

Pertaining to Recreation

TOY WAGON.—S. G. and B. C. PETTERSON, 225 Cedar St., Memphis, Tenn. The invention has for its object to provide a wagon with movable figures, the wagon body having at one end a crank shaft to which the supporting wheels are secured, and having guideways in which are movable slides, the slides being connected to the crank shaft to be reciprocated in opposite directions; the slides support a figure or figures and impart rotation thereto when they are reciprocated.

TOY AEROPLANE.—H. B. DUMMER, c/o Mrs. Stella G. Mack, 63 W. 11th St., New York, N. Y. The primary object of the invention is to provide a body which is in simulation of on aeroplane fuselage, said body being so constructed as to carry a book, pamphlet, or the like, which serves as the sustaining plane for the body, and in which the pamphlet serving as the plane may be readily removed.

Pertaining to Vehicles

RESILIENT WHEEL.—J. J. O'NEIL, 78 Butler St., Pittston, Pa. The invention has for its object to provide a wheel of the character specified wherein the wheel is so arranged that under shock and jar it may decrease in diameter and wherein spring mechanism is provided for absorbing shock and jar during the decrease in diameter of the wheel.

SHOCK CONTROLLER.—C. B. BILLINGHURST, 303 Dakota Ave., Pierre, S. D. The invention has for its object to provide mechanism to be arranged between the chassis and the body of the motor vehicle, for eliminating shock and jar, this mechanism consisting of flexible non-metallic, partly-elastic connections, which break the metallic connection between the body and the chassis.

CRANKING MECHANISM FOR EXPLOSIVE ENGINES.—E. N. CESAR, Ponca City, Okla. This invention has for an object to produce a cranking mechanism which is not liable to cause injury to the operator, by preventing careless or incorrect use. Another object is to produce a device which, if the crank should kick back as a result of premature explosion, or back-fire, injury to the operator will not ensue.

DIFFERENTIAL.—L. WATKINS, 826 St. Charles St., New Orleans, La. The object of this invention is to provide a construction which may be used either as a rear or front driving differential on a four-wheel driving vehicle. A further object is to provide a differential in which the usual arrangement of the internal gears and connecting members are limeinated and simple clutches substituted which may be manually actuated at the time that the clutch is thrown in and out or independent thereof for connecting and disconnecting the power shaft with the wheels.

Designs

DESIGN FOR A DOLL.—H. GOLDMAN, care M. Frankel, 354 E. 50th St., New York, N. Y. This inventor has been granted patent on three ornamental designs for a doll.

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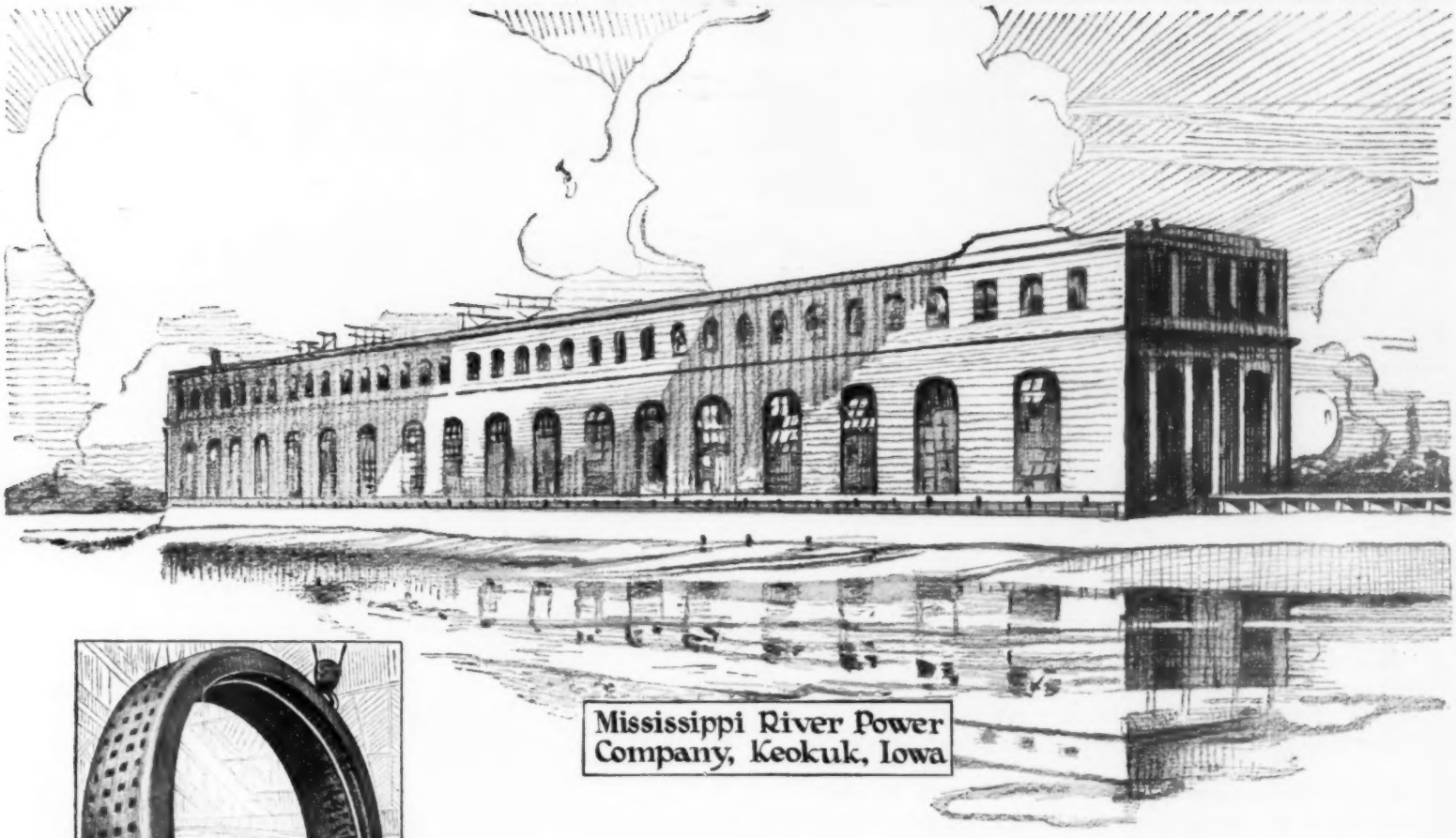
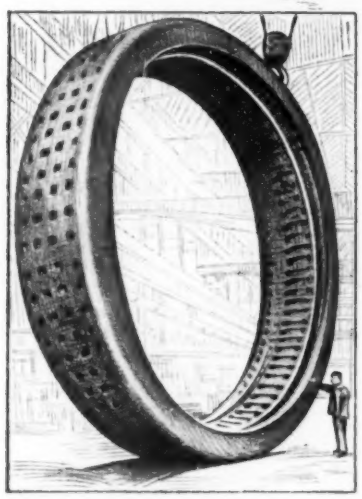


Mississippi River Power Company, Keokuk, Iowa



A casting for one of the huge water-wheel driven generators installed in the Mississippi River Power Company's plant at Keokuk. This installation will ultimately consist of thirty of these machines, giving a total capacity of 216,000 kilowatts (300,000 horsepower). It is the largest hydro-electric development in the world. The General Electric Company builds generators for water-wheel drive in sizes ranging from 37½ to 32,500 kilowatts and the aggregate capacity of G-E units now in successful operation is in excess of four million horsepower.

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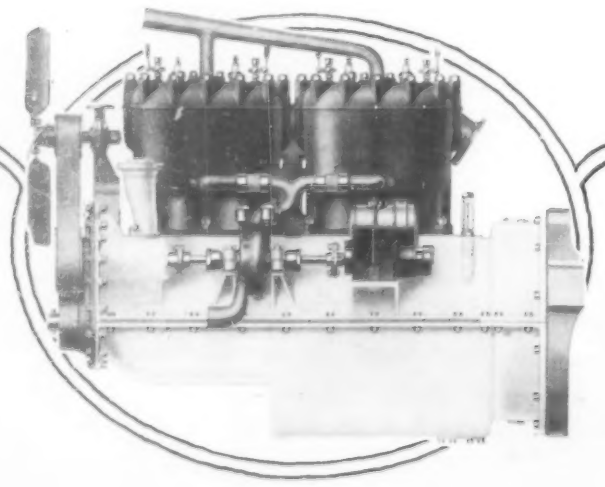


Is the Fabricated Ship a Success?

(Continued from page 386)

alined without violence, and are riveted up under ideal conditions which permit the rivets, when chilling and contracting, to bind metal to metal more securely. The rivets do not have the added tax of drawing neighboring surfaces in contact, and are therefore far less likely to shear and fall under the shifting stresses set up in a seaway. And don't let us forget that the bridgeman also recruited the tank builder when he essayed to embark upon naval architecture. This fact is of importance inasmuch as it brought to the new work men long engaged in forming metal containers designed to withstand pressures far in excess of that of the water supporting a ship at any possible draft. That is to say, they were accustomed to rivet up steel flumes for water-power projects where the head was hundreds and even thousands of feet.

And though the fabricated freighter, the standardized craft was of necessity hastened along at every stage of its manufacture, it is a notable fact that these boats have proved to be of a distinctly superior sort when gaged on a basis of bodily soundness. And bodily soundness is one of the prime factors which makes for low cost of upkeep, the safety of cargo in transit, and the length of time that a vessel will be fit to earn returns. Now what have been the showings in service of typical fabricated freighters produced during the period of the war crisis? A few cases will suffice to make it clear just what we have gained in marine architecture through union with the technique of structural engineering.

It is a far harder thing to build an oil-tight rather than a water-tight riveted tank. Somehow oil will work its way through the tiniest crevice. Oil tankers and other ships carrying liquid fuel in their interbottom compartments uniformly present a filthy condition externally below the waterline when placed in drydock, and all because the oil seeps outboard through seams and around rivets that are supposed to be perfectly sealed. What, then, was the amazement of the commander of an oil-burning fabricated freighter to find the bottom of his docked steamer clean so far as the least trace of exuding oil was concerned! Although his tanks were full of liquid fuel not a drop of it could get through the joints of the steel skin because of the manner in which the riveting had been done. This is quite typical of well-built ships of this type.

Last September, one of our manufactured cargo carriers was caught in a hurricane off the coast of Cuba, while light, and driven high upon the beach near Matanzas. For four months she wallowed in the sand and was finally "rocked off," by means of tugs, during rough weather. She was found to be tight and was sent north under her own power. It was not until the steamer reached Baltimore and was drydocked that it was discovered that her stern frame was broken. And right here we have evidence not only of sturdiness of hull but of another advantage in building identical ships by the fabricated process.

Ordinarily the replacement of that stern frame would have called for a protracted lay-up and the long occupation of a drydock, entailing heavy charges. But simply because the ship was of a standardized type, it was possible to have dispatched immediately, from stock, a duplicate stern frame, which was quickly substituted for the damaged one. Again, two other steamers—one a fabricated craft—collided head on, each smashing a hawse pipe. The fabricated vessel was able to obtain a new one from her building yard's reserve in the course of six hours, while the other boat was tied up for six weeks, during which time it was necessary to make a plan, then a pattern, and next a casting, after which the casting had to be machined and drilled preparatory to fitting it in place aboard.

It should be plain to anyone that the manufactured freighter enjoys a distinct advantage in having repairs made, particularly if in her home waters, inasmuch as equipment and injured parts can be supplied at once from stock on hand for either ships under construction or for emergencies. This means that the owner of a fabricated steamer will be able to keep her profitably engaged more nearly continuously than the ordinary craft contending with the wear and tear and the hazards of operation. Here we have an economic aspect of shipping which will inevitably figure importantly in making it possible for us to hold our own in world trade.

By recourse to quantity production and manufacturing methods, we have been able to provide identical steam generators, prime movers and a multiplicity of auxiliaries for our fabricated freighters. We chose water-tube boilers for these vessels for three reasons: first, they could be made quickly and assembled readily in the boats while on the blocks; second, they required much less steel than the generally-prevailing Scotch boiler of the merchant service; and, third, they could be more easily repaired by the average engineering force of a ship. A fourth advantage lies in the speed with which steam can be raised and the facility with which full working pressure can be maintained. This explains, in part, why so many of these craft have consistently run at higher speeds than they are rated. The water-tube boiler is an innovation in cargo carriers, but it is undeniably in the line of betterment.

The employment of the steam turbine in lieu of the reciprocating engine was likewise a notable departure which characterized the manufactured, standardized steamer; but our experience has proved this substitution to be in the direction of economy and efficient propulsion. There was trouble with the reduction gear as first installed, but the difficulty was discovered to be principally due to the original design of housing. This has been corrected, and the necessary strength is now assured as a safeguard against the crytsallizing effect of the vibration. Further, there has been developed for marine use another type of reduction gear which has, in addition to distinctive virtues, the merit of accessibility and ease of replacement of injured or worn parts. Contrary to assertions persistently made when the fabricated cargo carrier was first taken in hand by us, it is entirely practicable to model a hull that is susceptible of very easy drive and, withal, extremely seaworthy.

In brief, this type of standardized vessel can no longer be looked upon as a passing, wartime freak assembled to make a trip or two across the Atlantic and then to be scrapped if she did not fall a victim to the submarine. The fabricated ship in every department of her getup evidences engineering skill and a development in marine architecture that must endure by reason of inherent valuable characteristics. For some years to come our own needs as well as those of foreigners will demand an immense tonnage of ocean-going bottoms, and the manufactured, standardized boat especially is going to make it possible for us to do a big part towards meeting this demand.

Winged Patrols for Our Forests

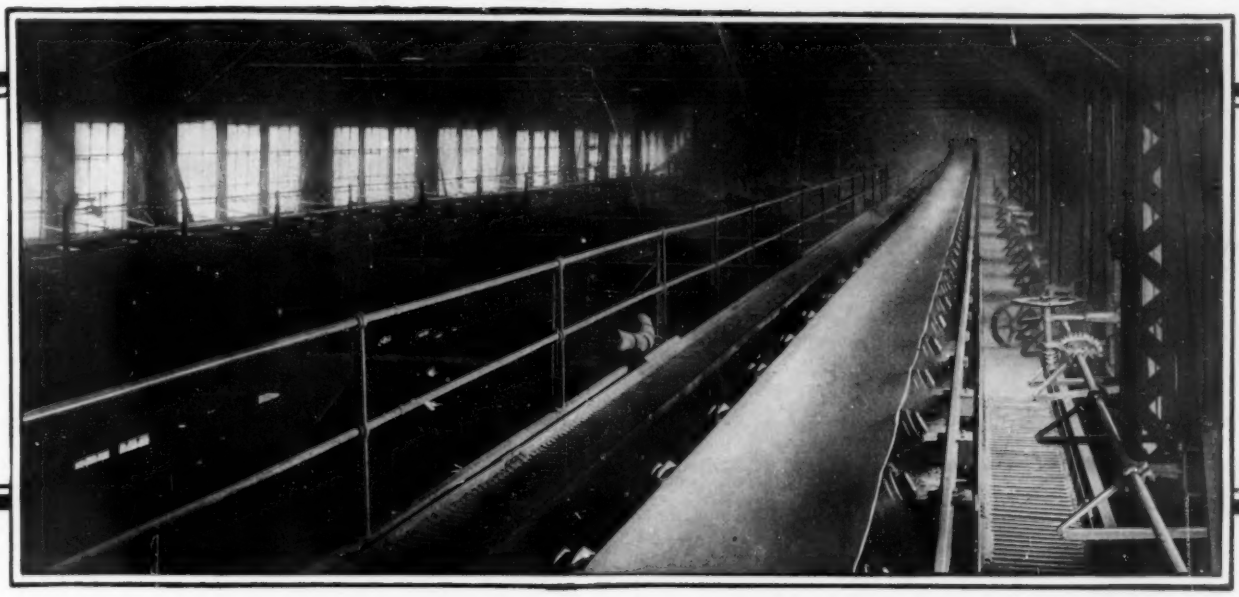
(Continued from page 387)

ized. Two new bases were established, new and much longer patrol routes were laid out, additional landing fields selected, and De Haviland "fours" were substituted for the smaller Curtiss plane.

Beginning September first the reorganized patrol, consisting of eight ships in

(Continued on page 406)

U.S. RUBBER CONVEYOR BELTS



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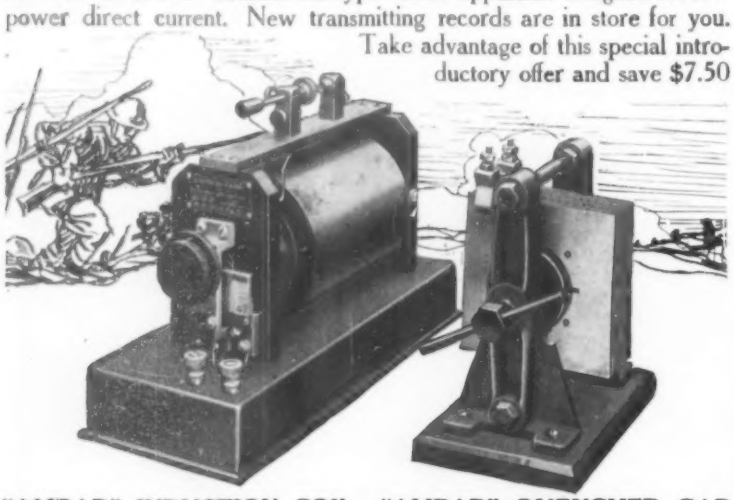

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Winged Patrols for Our Forests

(Continued from page 404)

operation and eight in reserve, covered, twice each day, 18 million acres of California's mountains—18 million acres on which grew Government timber worth more than 210 million dollars—acres, and timber, that extended from the Oregon line on the north to the Mexican on the south,—from the crest of the Sierras on the east nearly to the Pacific on the west, and from elevations of 1,500 feet to elevations of 11,000 feet.

This reorganized daily patrol was continued until October 31 when the fall rains put an end to the fire season. On that date the Air Service personnel assigned to fire patrol in California had run up a total of 2,457 flights, covered 202,000 miles, and had discovered, located and reported 442 fires. And this with but one fatality and six major accidents to planes, none of which proved even serious to pilot or observer!

Just what did this huge experiment prove? Many things. It proved that smokes—small smokes and large smokes, camp fires and conflagrations,—could be seen from one thousand feet and from 18,000 feet in elevation, that "discovery" was right around 85 per cent efficient. It proved that unbelievably accurate location of those smokes was possible—nay, more than possible, that it was practically sure. And this up to a radius of 35 miles when the ship was flying at an average height of 5,000 feet above the surrounding terrain and at a speed up to 150 miles an hour! It proved, by one experience in southern California near the end of the season, that the airplane has a very real practical value in directing the work of actual fire suppression; for as a result of short daily flights the Forest Supervisor was able to direct the movements of more than 2,000 fire fighters, pick locations for new camps, determine where new fire lines should be built, and keep his crew leaders informed at all times of the progress of fires which ultimately burned over some 160,000 acres of rough brushy country absolutely inaccessible except to men on foot.

Airplane patrol has proved, too, a big educational factor; so big a factor that the experiment might be considered a success from the standpoint of its educational value alone.

And if comparative figures are any criterion the flying lookout service may be said to have acted as a positive preventive measure. One southern California valley which has, until last year, been a veritable hotbed of incendiarism, has the proud and unique distinction of a fireless season to its credit. The reason may be that the inhabitants had, in some mysterious manner, gathered the impression that the air patrol, which covered the locality twice daily, was equipped both with powerful telescopes and machine guns. In any event it is of record that one side-hill rancher informed his neighbor that rather than run the chance of being detected in the act of burning some brush he had grubbed on his ranch, he would, if necessary, "dig a hole and bury it."

In one thing only—speaking now from the forester's point of view—did airplane fire patrol fail. That was in reporting fires. And that failure was due to the fact that methods of reporting—by small parachutes bearing messages, by carrier pigeon and by telephone after landing—were too slow. For time is (with accuracy) the essence of success in connection with forest fire suppression. It follows that failure in the reporting system—and slowness must be classed as failure—is serious. This is, however, a matter which it is expected will be overcome during the coming season, when wireless equipment and personnel, both of which were lacking last year, should allow reports to be received within five minutes after actual discovery.

Exploiting the Inventor—II

(Continued from page 388)

ventor in his work." Names are quoted with great freedom. Eminent men are invited to speak on the subject. A great hurrah is made over the philanthropic aspects of the scheme. One or two really eminent men in science, manufacture or finance are brought into the fold by methods already outlined and their names and reputations used to obtain others.

Subscriptions result—five hundred, a thousand, ten thousand dollars in a lump. But somehow the laboratories do not get built. The fund is never *quite* large enough to allow the actual work to be begun. Organization expenses are heavy—for the schemers have to live. The hullaballoo over, the hurrahs but echoes, the dinners all eaten—the "Foundation" slowly dries up and withers away. Those who have been bitten either drop the matter or protest and get their protests for their pains—nothing illegal has been done, accounts are all ready to be seen, everything is open and aboveboard—yet the undoubted fact remains that much money has been taken in from inventors on one side and philanthropists on the other *and nothing has been done for the inventor.*

The scheme is a good one from the standpoint of the man who wants money without working for it. But from the human standpoint it has little to recommend it over stealing coins from the cup of a blind beggar or knocking down the little girl who goes to the corner grocery for candy and taking away her pennies.

Inventors are often children, so far as business is concerned and frequently are blind to anything but their own immediate concerns. Agreed that out of thousands who take out patents every year only a small per cent are so foolish as to subscribe hard-earned money to a set of vague and gliteringly general promises. But this is a vast country; it takes but a few of the many to pay a handsome salary to the proponents of such a scheme. If two thousand men pay ten dollars each in a year, there results a tidy sum for some promoter to pay himself a salary; and of course all "subscriptions" are ultimately velvet.

The fee to become a member of the association or academy or whatever name it may use is generally ten or fifteen dollars per year. What protection does the inventor obtain in return? The promoters perhaps claim that membership entitles the inventor to free legal services of a patent lawyer and "one appearance in court." What would this amount to? The inventor is not called upon to appear in court at all save in case of infringement. In such event, whether he is bringing suit against another or another is bringing suit against him, he will if he is wise select his own lawyer and not leave his interests to the chance and hazard of being represented by the "attorney" of some association, who has no real interest in the fate of the patent and who makes the appearance without charge. If a suit is brought against an inventor for infringement, or if he is obliged to protect himself against the infringement of another, this is excellent evidence that his patent is of value; and in this case he will wish to protect his interests by securing the best professional assistance that he can obtain. The unwisest course possible would be for him to entrust his, perhaps, valuable interest to the casual assistance of a soulless institution which professes to perform this service for nothing. What you get for nothing is usually worth exactly what you pay for it.

The writer would not be understood as saying that no genuine inventors' association *could* be launched. He does not wish to be understood as saying, even, that no genuine scheme of the sort ever *has* been launched. But he knows of

(Continued on page 408)

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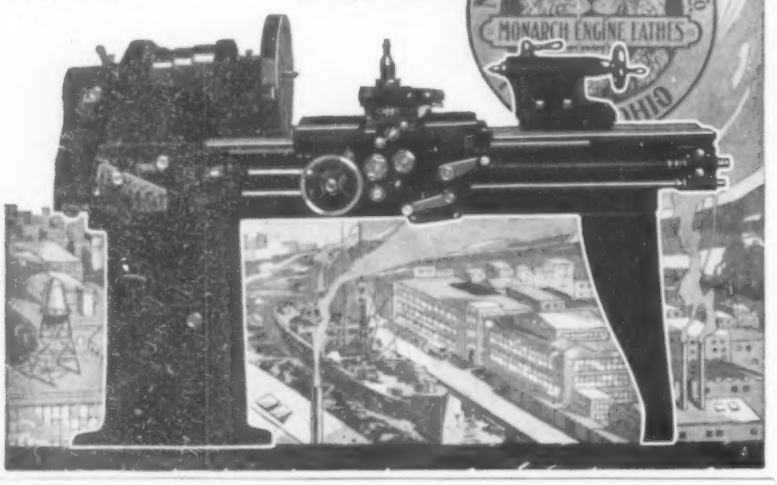

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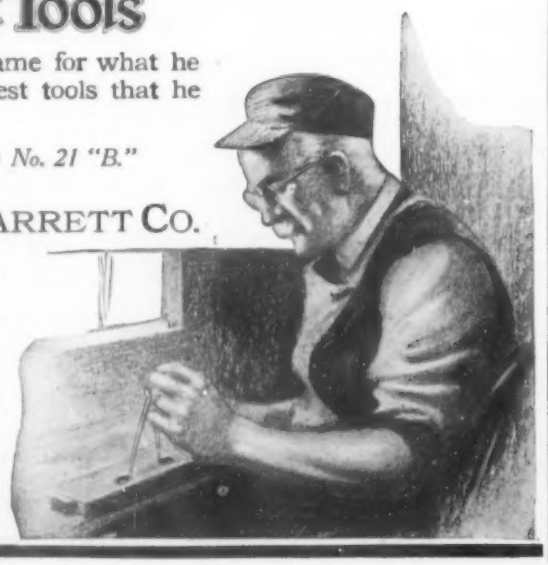


Exploiting the Inventor—II

(*Continued from page 406*)

none which has been launched and which has kept its promises when these were predicated upon such stipulations as those outlined above—and he is convinced from a long and intimate connection with invention and inventive matters, that the road to success *via* the patented invention, like the road to success in any other line of endeavor, does not usually lie through philanthropic aid, through promises of help for the sake of a small fee, through the free services of anyone. In his experience success is to be won through honest effort, real brains, careful and intelligent selection of assistants, and true merit. Given these, and as history shows, no meritorious patent has failed to make its way. Without these, the finest of inventions might as well never have been made.

Succeeding in Electrical Engineering

(*Continued from page 389*)

knowledge and his education should be carried to the university. The research electrical engineer must also be somewhat of a chemist and well versed in physics. His work is of a speculative nature and he must be a keen scientist to really succeed. All large electrical manufacturers have research laboratories where development work is constantly going on.

The application of electric power today is simply tremendous. The electric motor has almost entirely replaced the steam engine in factories. Millions of electric motors are in use and there is a good field for the specialist in electric motor design and construction. To give the reader an idea of just what has been done along this line the 25 h.-p. motor of twenty years ago was as large as the 100 h.-p. motor of today. This development work is constantly going on and the field for the motor expert is larger today than ever before.

The telephone and telegraph engineer has an unbounded eld to work in. This is a day of rapid communication and this communication is, of necessity, electrical, through the medium of the telephone and telegraph. (Wireless must also of course be considered as a part of electrical communication but this field has grown to such an extent that the author has decided to treat it in a separate article.)

Electrical illumination has grown to the point where the illuminating engineer takes his place among electrical specialists. Illumination today has been developed to a distinct science and men who have specialized in this line are capable of earning a very good living.

When the writer asked Dr. Sheldon what he considered to be the most important part of electrical engineering he unhesitatingly said mathematics. To be a good electrical engineer a man must first be a mathematician. Mathematics is the very backbone of electrical engineering science. When Dr. Sheldon was asked how far a man should go in the study of mathematics he remarked that he should go as far as mathematics would carry him, or the point where mathematics stopped. He said that the great success of Dr. Steinmetz, who is one of the most famous electrical engineers in the world today, can be attributed to his understanding of mathematics. Dr. Steinmetz is a man who dreams in mathematics and he is capable of applying mathematical analysis to the most complex engineering problems. The day of the slide rule engineer is past.

The electrical engineer when he first leaves college is not able to command a large salary. The General Electric Company pays beginners from twenty to twenty-five dollars per week for the first year. After this the salary gradually increases according to ability and after the first five years has passed from $3,000 to $4,000 per year is a common salary. From this point the salary of an electrical engineer may reach anything up to $30,000 per year. In a few cases salaries have been known to go beyond this point. It has been said that Dr. Steinmetz has an income that is nearly as large as that of the President of the United States. After an electrical engineer has served from five to ten years out of college it may be said that $5,000 is the average salary. Some attain this figure and some do not.

Before entering college to take up the study of any particular work, many young men desire to know whether or not there are possibilities of going into business for themselves. The opportunity for private enterprises in the electrical industry is very great. This is not so true of the manufacturing end as it is of the contracting and supply end. Electrical contracting in a big way brings large returns. The mere installation of lighting systems is a very small part of the electrical contracting business. It is the installation of power equipment that forms the basis of this part of the industry. The electrical contractor who receives a contract to install the lighting and power equipment in a modern hotel, for instance, has a job on his hands that will amount to many thousand dollars. Such installation must be made under the direction of a capable engineer. In fact, contractors undertaking such work generally employ several engineers; illuminating engineers, power engineers, etc.

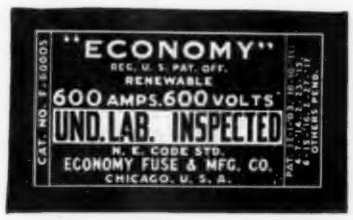
Aside from the contracting field, there is the consulting field. To be a real successful consulting engineer, a man should have more than a mere college education unless he has had a number of years of experience before entering a consulting practice. The consulting engineer must be an expert along general lines—he must have a thorough and broad training. Of course some consulting engineers specialize in various lines but the beginner will find it extremely difficult to confine his attention to any one field and earn his living. After a business has been successfully started, it can be gradually confined to one special line. Some consulting engineers limit their work to power plants, others to power equipment, some to illumination, etc.

A good, reliable consulting electrical engineer has an income ranging from $5,000 to $20,000 per year, depending upon the extent of his business. Unlike the contracting business, the consulting practice does not require a great deal of capital to start with. If a man has enough money saved to live on for a year, the possibilities are that he can develop a good paying consulting practice providing he has used discretion in the choice of his location. A consulting engineer should keep himself in constant touch with all new developments in most every branch of the electrical industry, especially if he is not a specialist in any particular line.

The man who is unable to attend college and who desires to enter the profession of electrical engineering should by no means give up in dispair. Dr. Shelden mentioned several men in the field who had climbed to very high salaried positions without the advantage of college training. Such men prove that it is possible to succeed by sheer pluck and hard work.

The young man who has decided to train himself should first obtain a position with some large electrical manufacturer. Most employers are sympathetic with young men who are educating themselves and if possible arrangements should be made to work several months in different departments as this experience will be invaluable. It must be remembered that the smaller manufacturers are not able to offer the advantages in this respect that the larger manufacturers are able to offer. The larger manufacturer also employs higher salaried men whose advice and counsel are both inspiring and helpful.

The study of mathematics is by far the



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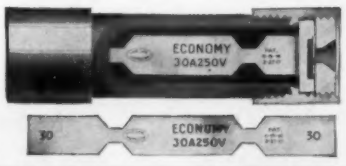

greatest obstacle to the man training himself out of college. Often times it is possible to obtain the kind assistance of one well versed in mathematics and the value of such help cannot be overestimated. The well-trained engineer should be able to use algebra, calculus, trigonometry, plane and solid geometry, etc. Armed with a good understanding of mathematics, engineering literature of an advanced order can be read and digested. The writer has heard it said again and again by men in a position to know, that the young man seeking a training outside of college should start in by mastering mathematics.

Mathematics should be followed up with the study of physics. When this study is completed the real electrical study can begin. Too much stress cannot be laid on the importance of the proper choice of text-books. Only standard works prepared by well-known authorities should be used. Unreliable data or information assimilated and put to use at a later date may cause any amount of trouble and expense to say nothing of lost prestige. By the intelligent choice of engineering literature, the student can so arrange his study that each volume read and digested will be a little in advance of the previous volume. This is sort of a "stepping stone" method and is far more advisable than choosing literature at random. The joining of the American Institute of Electrical Engineers will help a young man interested in the electrical industry as it will bring him in touch with successful engineers in all branches of the field. Great benefit will also be derived from meetings and discussions. Contrary to the general opinion, it is not necessary to be an electrical engineer to join this body as a Junior Member.

The electrical industry ranks among the first in the United States and no field offers more to the well-trained man. To give one a good idea of just how large the industry is, it is said that one of our large manufacturers does one million dollars worth of business every day in the year.

How Much Is a Worker Worth?

(*Continued from page 390*)

pany the use of electricity are serious, but like viciousness they become less dangerous when completely familiar. Fire, water, compressed air, steam and drugs are safe as harnessed energy, only when confined and intelligently employed.

The danger in the use of electricity is in direct ratio to the ignorance, carelessness, and the smart-alickness of the individuals that come in contact with it. Uniquely as a hazard it is not seen and the visible conductors that carry the current look harmless.

An electrical engineer operating a central station in the South, related an incident that illustrates this point. An employee working his last day, became a trifle fresh. Looking for a match to light a cigarette, he stepped up to an open knife switch and having previously noticed a small arc there, conceived the idea of opening the switch slightly and getting a light from this arc. It was a three-phase circuit, carrying 16,000 volts. Some one was working on the line, throwing on an extra heavy load. He opened the switch, holding his cigarette in his mouth close to the contact. An arc flashed out into the room nearly enveloping the fool. He remained six weeks in a darkened room to save his eyesight. Ignorance may be an excuse in industry, but where there are hazards, there is no trial by jury. The verdict and punishment come simultaneously with the offense.

To determine the seriousness of the various causes of accident by consideration of the number only resulting from each cause is misleading. Of accidents reported by one chain of companies, 8.3 per cent were caused by electric current. A cursory analysis of this ratio, would

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indicate that relatively little attention need be paid to accidents caused by electric current and that intensive work should be directed toward the elimination of hazards which accounted for the remaining 91.7 per cent. A critical analysis, however, revealed that these electric current accidents were responsible for over 70 per cent of the total lost time (excluding the fatal accidents) and 70 per cent of the very serious and fatal accidents. Furthermore, 71 per cent of the total amount of money expended for compensation and accident cost, was paid out for accidents caused by electric current.

In the central station where the current is generated and at the sub-stations, where it is stepped down for distribution at lower voltages, safety precautions and devices have been developed and applied with scientific thoroughness.

Linemen, when on duty are rigidly protected from a switch being inadvertently closed. A leather envelope is often used as a tag to be hung on the switch controlling the circuit to be protected—on one side of the envelope is printed the customary warning that "men are working on the circuit"; the envelope containing a complete history of the service being rendered. The lineman hangs and removes the envelope himself.

Often a lineman, because of public demands, must work with the line alive. Here it is imperative to use safety belts, rubber gloves, rubber armlets and protective shields.

With all the precautions, there is an ever present element of danger in the central station and the safety and comfort of the public is insured by the risks that these men assume. To the lineman every person owes a debt of gratitude.

An example of the risk that even the intelligent, trained electrician must take, is illustrated by the following incident: An oil can was suspended on a pipe structure, directly above a 23,000 volt busbar on a three-phase open switch; it became unhooked and dropped slightly away from the support. The operator, wishing to lift the can in place and thinking to practice safety, tripped the switch by the use of an open relay in the rear of the board. He then opened one of the three disconnecting blades between the switch and the bus. Being in a hurry to restore the circuit, he opened the switch blade promptly, with the result that an arc was established, which blinded three men and blew into the bus, shutting down the station.

This discussion has perhaps inordinately concerned itself with electrical hazards, but not without a reason, when one stops to reflect that a consideration of these hazards because of the increased adoption of electrical current, is paramount. However, the number of workers, who gain their livelihood at the expense of health and not infrequently life, in other industries is considerable.

Many occupations of older standing than electricity, require that those who follow them should work constantly in an atmosphere of dust. Coal mining, quarrying, fur-beating, and file-cutting, each takes a heavy toll of its votaries every year. The man who is regularly working in an atmosphere laden with particles of grit and dust and foreign bodies of a similar nature, perforce breathes these impurities, and the effect on the lungs is often disastrous. Nearly 73 per cent of the deaths among grinders, polishers and cutlers, result from diseases of the lungs.

Metallic dust is the most harmful, while mineral dust with which masons and pottery-workers largely have to contend, is a good second. Cotton and wool-workers, too, are constantly inhaling fiber-dust, with in the long run, equally grave results, while the more familiar chimney-sweep is externally liable to become the prey of cancerous growths.

Bad air and extremes in heat and cold conspire to shorten the lives of workers in other spheres of labor. Sewer-men and

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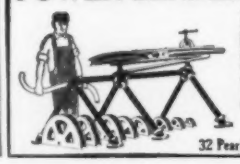

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miners of almost all classes suffer the effects of impure atmospheric conditions, while glass-blowers are prone to loss vitally by reason of their constant exposure to high temperatures.

Cotton-spinners work in a warm atmosphere; the damp air prevents the fiber from becoming brittle and thus snapping, and in consequence, these workers often suffer from complaints of the chest.

But undoubtedly the most dangerous employment of this kind, is that from which the worker can and often does, contract metallic poisoning. Lead poison for example, affects no fewer than 13 different trades, being particularly fatal to those who are engaged in the production of white lead.

The problem of accident prevention is like the problem of the monks on Mount Monserat. Their monastery was builded far above the clouds, close to the snow capped peaks, where little life could long survive. Strangely this order of celibates conceived the idea of raising oranges in the garden at the front of the chapel. Going to the sunny valley below, they procured saplings which were transplanted but a short distance up the slope. As the trees grew, slowly adapting themselves to a slightly colder climate, they were again transplanted farther up the mountain side. Several generations of monks lived and died ere the orange trees were finally growing in the garden before the chapel—a changed tree, bearing a small, sweet, delicious fruit, absolutely adapted to the rare atmosphere of the snow-clad summit.

Thus it is with the preservation of human life. Industry cannot stop maiming and killing entirely, but it can each year decrease the rate until finally an industrial accident will not be absolutely unavoidable.

Fighting Plant Pests With Fire

(*Continued from page 392*)

the corn borer is not injurious and does not eat any solid food. The moths mate soon after emergence. They hide in patches of grassland or underneath plant leaves during the day and sneak forth at night to deposit their eggs on the undersides of plant leaves where the eggs hatch in from five to nine days. The newly hatched borers feed upon the plant surfaces and tassels for a few days and then burrow into the plant and complete their growth in concealment. About one and one-half months after hatching, the borers attain maturity and transform to the pupa stage. Ten days later, the moths of the next generation appear and deposit their eggs as has been previously described.

It is only the larvae or worms that are harmful, the moths doing no damage of themselves. A full-grown borer is an inch or so long and an eighth of an inch thick. While the head is of a dark brown color, the upper surface of the body varies from brown to pink, while the under side of the body is flesh-colored. There are rows of dark brown spots on the body. The moths that lay their eggs in the early part of the season average about 350 eggs each, while those from the next generation lay about 550 eggs each. So it will be seen how easy it is for the insect to propagate itself and how thoroughly the fields must be cleaned up to eradicate it. A ray of hope is found in the fact that in the outbreaks in New York State there was but one brood of the borers and consequently the damage was greatly lessened. However, entomologists believe that in the South there might be three generations, should it get a start. If corn is not available the pest will feed on other plants, such as chrysanthemums, Swiss chard, beets, spinach, celery, beans, oats, potatoes, turnips, tomatoes, dahlias, gladiolus, geraniums and timothy.

The same shipment of broom corn that is believed to have brought the pest to Massachusetts was widely distributed over the Middle West and so there is a possibility that it may break out at any time in the Corn Belt. On the other hand, the fact that no serious damage has as yet been noticed means that there is a possibility that nothing will come of it. But in view of the dire possibilities, the Department of Agriculture has been active in seeking means of defense against this pest.

The most efficient control measures which have been devised by the Federal farming experts consist in suppressing the pest and limiting the area of infection as far as possible by destroying by fire or other means during the fall, winter or early spring months all the cornstalks, corn stubble, crop remnants and stalks of garden plants, weeds or wild grasses within infected regions as the overwintering borers hibernate in materials of this description. In all sections of the United States where the European corn borer disease has appeared, Federal, State and local authorities are united in the common labor of stamping out and controlling as far as is humanly possible the further distribution of the crop scourge. For effective, longtime results it is essential that every clean-up campaign be infinitesimally painstaking and particular; for in case only a baker's dozer of borers are overlooked, the entire eradication labors have been fruitless as this number of the criminals is adequate to extend the damage and soon effect as enormous infestation as originally obtained in the neighborhood under discussion. To prevent the spread of the dreaded disease, both State and Federal quarantines are instituted whenever the need for such drastic action arises. Otherwise infested plants or plant products could be shipped from territories where the disease was rampant to adjoining or distant neighborhoods which were contamination-free and thereby the infection might be scattered broadcast throughout the chief corn producing sections, to the ultimate and lasting discomfiture of the corn growing fraternity.

Uncle Sam, through his official representative, the National Department of Agriculture, has efficaciously practiced methods of firing infested fields, destroying all the light debris which was capable of quartering the overwintering borers. Were infested fields to be cleaned up by hand labor, the cost would be prohibitive, amounting to from $50 to $60 an acre, whereas the same control measures can be carried out by the use of complete conflagration at an expense of $12 to $14 an acre. Even this expense is excessive where extensive tracts are to be treated and in such instances, the practice is to utilize the fires principally to limit and restrict the spread of the infection to certain, definite borders.

In exterminating infection, it is necessary to destroy every individual plant which has been exposed to contamination. This includes the destruction of all the stubble and the upper portions of the plant roots. A few infected plants which may escape the clean-up suffice in many instances to form the nucleus of an army of insects almost as numerous as the hordes which instituted the original infection. To facilitate the destruction of crop aftermath and accumulated debris, a mixture of light fuel oil and kerosene is often sprayed over the crop residues and stubble and then ignited. A forty horse-power automobile truck is used as the supply source of the fuel, the oil under a pressure of 400 pounds per square inch being delivered to distributing devices by means of rubber hose and thus sprayed over the field. A two-wheeled cart which carries a fifteen-foot length of three-quarter-inch pipe which is provided with a spray nozzle every sixteen inches along its length is utilized as an efficient fire cart, the attendant who propels the novel fuel wagon, keeping far enough away from the flames to avoid injury.

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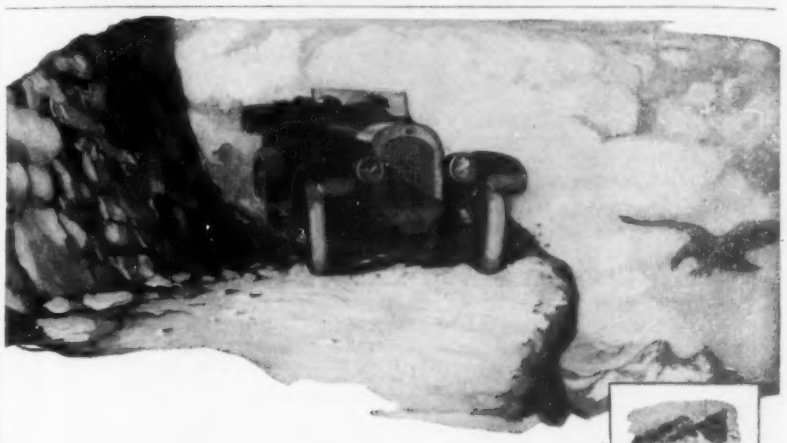

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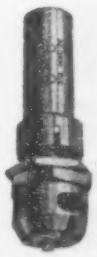

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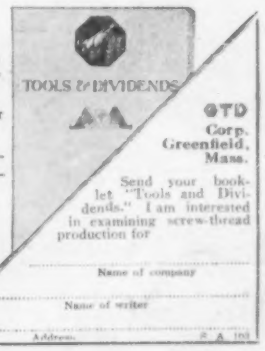

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The quality of W. L. Douglas product is guaranteed by more than 40 years experience in making fine shoes. The smart styles are the leaders in the fashion centers of America. They are made in a well-equipped factory at Brockton, Mass., by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy. The retail prices are the same everywhere. They cost no more in San Francisco than they do in New York.

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

CAUTION.—Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. If it has been changed or mutilated, BEWARE OF FRAUD.

W. L. Douglas President

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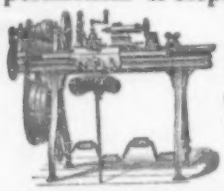

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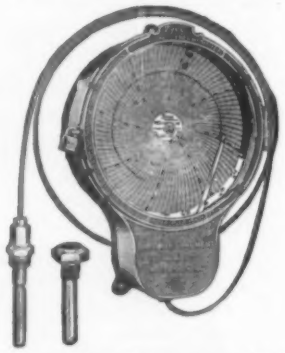

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A small hand gun is also used to burn out fence rows and fence corners in situations where it is impossible to use the fire cart. Pure kerosene is used as fuel in this unique blow torch. Army flame-throwers which were used extensively during the recent world war have also been tested out but were found to be unsuitable for use in burning infested cornfields because it costs $1 a minute to operate these instruments. The capacity of the average flame-thrower is so small that in thirty seconds all the inflammable material which it contains is consumed, the cost of this material per charge being fifty cents.

In cornfields where the fodder is not used for feed, the plants may be pulled up by the roots, or plowed out, and subsequently may be collected in piles and burned. In case the stalks are cut for forage purposes, the stubble should be plowed, raked into piles and fired. Refuse from infected vegetable and flower gardens should be handled in a similar way. Where field conditions are unfavorable to the establishment and support of a running fire as a method of control, the best plan is to mow the field as close as possible and thereafter to destroy the stubble. Even though the expenses of eradicating the corn borers from contaminated areas are large, such costs are much smaller proportionally than would be the sum aggregate of the monetary losses which would obtain in the form of ruined crops were the infestation not properly and promptly controlled and corraled within certain borders, pending its complete extinction.

Arsenical poisons have also been tested out experimentally to ascertain their value as a control of the European corn borer. The expenses of applying these poisonous materials have been practically prohibitive due to the fact that several applications are necessary as corn grows very rapidly during the period when the injury is most acute. Furthermore, only a portion of the insects is killed as the pestiferous rogues feed on the surface of the plants and leaf blades for only a few days during their early life. Hence the use of arsenicals has never been recommended as a sure shot remedy for borer domination in a cornfield.

The plowing under of the infested material has not proved a practical or certain control as it is almost impossible for the average plowman to turn under all of the stubble and trash and enough of the aftermath usually remains above ground to harbor sufficient borers to extend the infection to the succeeding crop. Furthermore, even if the infested material is plowed under, unless it is covered to a considerable depth, enough of the borers will make their way to the surface to spread the disease.

In eastern Massachusetts where the damage has been most severe and where sweet corn has been the favorite crop for the activities of the borers, one of the most practical control measures has obtained from planting the corn the latter part of April or early in May so that at the time when the first brood of moths hatches out the corn will not be in the tassel stage, a condition which usually is unfavorable to the development of the insects. As a result the crop parasites ordinarily deposit their eggs on weeds or grasses which carry green seedheads at this period and hence provide ideal conditions for the rapid growth of the insects. On the other hand, early-planted corn usually tassels out just about the time the first brood of moths are depositing their eggs and hence supplies a satisfactory host plant for the operations of the borers which soon emerge.

Building with Cinders

(*Continued from page 393*)

pleasant surprise to the engineers and immediately "Cindertown" or the more dignified name of "Overlook" was authorized as a reality, to be built of cinders. Seventy-five homes were erected of this material—a monument to enterprise and ingenuity.

"Houses were urgently needed for the workmen making munition chemicals," says Milton Dana Morrill, architect and engineer, in relating the story descriptive of the exigencies which prompted the construction of "Cindertown." "There was a scarcity of ordinary building materials, and transportation was a difficult matter, even if these could be purchased.

"Investigation showed that there was an ample supply close at hand of crushed coal cinders, ordinarily considered a waste product, for making cinder concrete. Samples were taken and test blocks made, and the cinders were analyzed for sulphur, as a high percentage of sulphur affects the strength of the concrete. These tests blocks showed a crushing strength of 1,800 pounds a square inch, whereas in the ordinary house walls the load seldom exceeds 120 pounds a square inch."

Making Boro-Budur Known

(*Continued from page 398*)

as seen in another view. From the plain similar stairs lead up to the irregularly-shaped galleries and on to the great circular one surrounding the dome, the latter thus being reached without it being necessary to pass through the intervening ones. Each of these many-angled terraces is about ten feet above the preceding one, with a width between the walls of about seven feet, and is drained by gargoyles representing mythical monsters, through the mouths of which the water is led.

At each angle is a Buddha seated in a niche. It is surmounted by a cupola. One of these is shown in one of our views. The Buddha is seated upon a lotus leaf with a halo around its head. The figure is almost nude. As the viewer passes around these galleries both sides are seen to consist of a series of sculptured pictures, surmounted with domes and pinnacles with Buddhas on all sides gazing at one with their inscrutable eyes. All the wonderfully artistic scenes are from the life of Buddha, depicting it from the time he left his lotus leaf throne to descend to earth, and his successive reincarnations until attaining Nirvana the desired spiritual haven of Buddhism.

From the fourth gallery access to the upper level is gained by a stairs of twelve steps. This level has only an outer wall upon which is erected three circular terraces, one rising a few feet above the other. Upon this are 72 remarkably uniform lattice-worked stone *dagabas* or shrines, each culminating in a slender spire as shown in the remaining view. These may also be noted in connection with the general view by studying same critically. Each of these beautiful bell-shaped shrines contains a statue of Buddha, each statue facing toward the central dome, which signifies that it is utterly detached from all the temptations and cares of this wicked world.

Such is a brief description of the main points of Boro-Budur, the world's greatest temple, and the finest example of ancient Indian art, which will soon be made accessible by airplane. Perhaps in the years to come this world wonder may attain fame equal to that of the Great Pyramid. But at present it stands utterly unknown to the world at large.

Measuring Carbon Content of Steel

THE Bureau of Standards, in Technologic Paper No. 141, entitled "An Electrolytic Resistance Method for Determining Carbon in Steel," describes methods and apparatus for rapidly and accurately determining carbon in steel by absorbing in a solution of barium hydroxide the carbon dioxide resulting from direct combustion of the metal in oxygen, and deducing the carbon content from the change in electrical resistance of the barium hydroxide solution.